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PAPERS IN PRESS FOR FORTHCOMING ISSUES

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This paper is accompanied by a colored geologic map, 36 by 45 inches, scale 1:50,000. A limited number of copies of the map, unfolded and in tubes, will be available.

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DIAGENESIS OF THE CLINTON HEMATITE ORES OF NEW YORK. By H. L. Alling

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BULLETIN OF THE GEOLOGICAL SOCIETY OF AMERICA
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WAVE EROSION ALONG THE SOUTHERN CALIFORNIA COAST

BY F. P. SHEPARD AND U. S. GRANT IV

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ABSTRACT

Wide wave-cut terraces along the southern California coast are apparently in accord with the present stand of the sea and therefore must have been cut within the last few thousand years. Photographic comparisons, however, indicate that the erosion of rocky coasts has been negligible in the past 50 years even where the rocks are relatively soft shales. Narrow projecting points, stacks, and sea arches have suffered some erosion, but the straighter sections of rock cliffs look untouched. On the other hand, photographs and measurements indicate a retreat of unconsolidated formations on the open coast of as much as a foot per year. The erosion of unconsolidated materials near the Scripps Institution is going on at a decreasing rate judging from a comparison of three sets of measurements spaced over the past 28 years.

INTRODUCTION

Old residents of coastal communities often express opinions that within a generation or two local sea cliffs have undergone great erosion. The reality of such erosion

is attested by the undermining of shore property during hurricanes like that of 1938 on the east coast (Brown, 1939) and by tidal waves such as occurred on April 1, 1946, in the Hawaiian Islands. Even ordinary storm waves may make deep inroads into a coast line so that owners of summer cottages may find that their homes have been ruined by the retreat of the adjacent sea cliff during their absence in winter. Figures of the rate of erosion of sea cliffs have, however, given somewhat erroneous impressions of the power and effect of wave attack because these figures do not always differentiate between easily eroded and resistant coastal formations. Thus the rapid retreats during hurricanes and tidal waves, insofar as the writers know, have taken place only in unconsolidated formations.

Before unduly alarming owners of coastal property by tales of rapid cutting back of cliffs one should give more consideration to the effect of waves on various types of formations. Johnson (1925) called attention to the extremely variable erosion rates on the hard-rock and on the weak-rock coasts of New England and Acadia. From his illustrations of weak-rock coasts of New Brunswick and Cape Breton Island one gathers that rapid wave erosion of weak rocks may be expected. To test the rate of erosion in weak-rock formations more completely the writers have collected old photographs (some of them dating back to 1887) of the weak-rock coastal cliffs in Southern California. These photographs were retaken, where possible, from the same position to see what had happened in the interim. For comparative purposes studies have been made of cliffs consisting of unconsolidated formations, of soft Tertiary formations, of more resistant Cretaceous sandstones, and of other older formations. This investigation has been going on for the past 11 years, and it is now possible to obtain information on erosion rates from many coastal areas where old photographs were not available.

ACKNOWLEDGMENTS

Some of the field and photographic expenses were defrayed by a grant to the junior author from the Penrose Bequest of The Geological Society of America. Help was also received from the Scripps Institution and the University of California at Los Angeles. Numerous individuals provided the writers with old photographs which helped in determining the extent of erosion of the sea cliffs. This work represents in part the results of research carried out by the Hydrographic Office and the Bureau of Ships of the Navy Dept., under contract with the University of California.

FACTORS INVOLVED IN WAVE EROSION OF ROCKY COASTS

HARDNESS OF THE ROCK

Soft Tertiary shales which are abundant along the California coast should be easily eroded by the crystalline gravel and cobbles, which are available along many beaches and can be thrown against the sea cliffs. At the other extreme are the crystalline rocks which are rare along the southern California coasts. Intermediate types such as sandstones may have relatively soft cement.

PLANES OF STRUCTURAL WEAKNESS

Rocks with many joint cracks or other openings in which waves can compress the air and cause explosive recoil are more subject to erosion than those which are relatively free from such openings.

COASTAL CONFIGURATION

Straight cliffs offer much less chance for successful wave attack than extremely irregular coasts where the waves can work into clefts and under arches and around stacks and projecting points.

SOLUBILITY OF ROCKS AND ROCK CEMENT

Solution is an important factor in cliff recession as has been shown by Emery (1941). Limestones and any rock with calcareous cement may be dissolved as a result of the organisms living in tide pools or in the wet crevices of cliff faces. These organisms, according to Emery (personal communication), increase the acidity of the water during the night so that solution of calcium carbonate may take place whereas normal sea water is too saturated to allow solution.

HEIGHT OF CLIFFS

High cliffs recede more slowly than low ones because the undercutting of the high cliffs causes large landslides which in turn must be removed by the waves before recession can continue. On the other hand the top of a high cliff may recede more rapidly at least for a number of years because of the slides which take place.

NATURE OF WAVE ATTACK

There are many reasons for more concentrated wave attack on one part of a coast than another. Headlands are usually the loci of heavy wave attack because of submarine projections beyond the headlands which cause the waves to converge and thus increase their height (Munk, 1947). Deep water adjacent to the coast, as for example a submarine valley, will result in wave divergence and in correspondingly low waves reaching the shore. The presence of reefs outside the coast will break the power of the waves particularly if there are deep-water zones between the reef and the shore.

OBSERVED CHANGES

During the investigation of cliff erosion the writers attempted to locate the exact position from which old photographs were obtained. To accomplish this ranges were sought near the left- and right-hand sides of the old photographs. Also objects in the foreground were checked with special care to make the duplication as close as possible. When one considers that most pictures of sea cliffs are taken near the edge of the cliff it is easy to see that any appreciable retreat would make it virtually impossible to retake the photograph from the same point. Despite the fact that the new photographs were taken after an interval of from 29 to 59 years, it was necessary

in only one place to duplicate the photograph by holding the camera out beyond the rock cliff.

Undoubted changes have been observed at a few places. All of these changes, however, have been either the toppling over of an arch (Pl. 1, figs. 1, 2), the removal of a stack (Pl. 1, figs. 3, 4), the partial collapse of the roof of a sea cave (Pl. 2, fig. 1), or the development of a landslide which was not directly the result of wave action.

Cathedral Arch off La Jolla (Pl. 1, figs. 1, 2) was destroyed shortly after 1900. Up to 1921 both buttresses of the arch were left standing; some time between 1921 and 1937 the eastern buttress was removed. The remaining stack has undergone slight changes since that time. This erosion has taken place at a point where the waves converge because of a turn in the coast, although wave attack is somewhat decreased by the ledges which protect the wave approach from the west. The rock is a massive, comparatively well cemented Cretaceous sandstone with a small number of joints. The cement is calcareous. Similar collapse of an arch took place at Sunset Cliffs on Point Loma between 1938 and 1940. The material here was crumbly shale. Also a small shale arch collapsed a few miles north of La Jolla in 1941.

A photograph was taken in 1887 from the firmly cemented sandstone cliffs at the south side of Ocean Beach. The location is at a point of wave convergence and is unprotected from the free sweep of the waves. The old photograph (Pl. 1, fig. 3) showed a stack which is now completely eroded. Also the photograph was taken from another stack, where it was impossible to get a picture from exactly the same position. However, retreat has not been very great and is largely confined to projecting stacks.

South of Ocean Beach the road was constructed directly over a cave. The writers have known of this cave for 20 years. No trouble was experienced until the spring of 1946 when a partial roof collapse took place (Pl. 2, fig. 1). It does not seem likely that wave attack during this period had much if anything to do with the collapse.

Old photographs of the well-known caves which flank the north side of the La Jolla Peninsula show that a collapse has taken place here also. The arch over one cave gave away about 20 years ago. The rock here is also Cretaceous sandstone. The water along the cliffs is about 10 feet deep, and waves do not ordinarily break with any force against the cliffs. The collapse may have been due to forces other than waves although originally the caves were in all probability a wave product.

In contrast to these localities where changes were observed we have found innumerable localities where there has been essentially no modification for half a century. Surprisingly, in localities where erosion appears to have been inconsequential, high sea cliffs, sea caves, and wide wave-cut platforms exposed at low tide all testify to the importance of wave erosion in the past. Since it is unbelievable that the California coast with its abundant raised and tilted terraces could have long stood still, the finding of level benches exposed at low tide such as the one in Figure 2 of Plate 2 must indicate a fairly rapid rate of erosion. It is unlikely that the sea level has stood still more than a couple of thousand years. The low elevated terraces of the islands of the Pacific and most coasts of the world testify to the recent negative shift of sea level suggested by Daly (1920) and supported by most other investigators. If the bench in Figure 2 of Plate 2 was formed in approximately 2000 years, the rate of

FIGURE 1. CATHEDRAL ARCH AT LA JOLLA IN 1900

FIGURE 2. THE WESTERN BUTTRESS OF CATHEDRAL ARCH IN 1937

FIGURE 3. THE CLIFFS AT OCEAN BEACH IN 1887

FIGURE 4. THE OCEAN BEACH CLIFFS FROM APPROXIMATELY THE SAME POSITION IN 1946.

Note the stack in center of figure 3 has disappeared, also the stack on the left has been considerably reduced, and the position from which the picture was taken could not be reached because of erosion of another stack. (Photo by W. F. Jewell.)

WAVE EROSION AT LA JOLLA AND OCEAN BEACH, SAN DIEGO COUNTY

FIGURE 1. THE RECENTLY COLLAPSED ROOF OF A CAVE AT SUNSET CLIFFS WHICH HAS UNDERMINED THE ROAD.
The remnant of the cave extends for 60 feet under the road. (Photo by W. F. Jewell, April 1, 1946.)

FIGURE 2. WAVE-CUT TERRACE EXPOSED AT LOW TIDE AT THE BASE OF THE 100 FOOT CLIFF JUST NORTH OF THE LA JOLLA CAVES.
(Photo by Paul Williams, November 21, 1945.)

FIGURE 3. LA JOLLA COVE IN 1906
(Photo by Herbert R. Fitch.)

FIGURE 4. LA JOLLA COVE IN 1945.
Note the numerous concretions in the hard Cretaceous sandstone which can be matched with the concretions in Figure 3. (Photo by U. S. Grant IV.)

SHORE LINE FEATURES ON POINT LOMA AND AT LA JOLLA

erosion must have averaged a foot in 4 years. This rate has not been maintained since no appreciable change can be seen in the past 40 years although slight cutting has taken place locally, and landslides have occurred near the top of the cliffs.

The inconsequential rate of erosion of the Cretaceous sandstone around La Jolla Cove in 40 years is shown in Figures 3 and 4 of Plate 2. Comparing the old and new

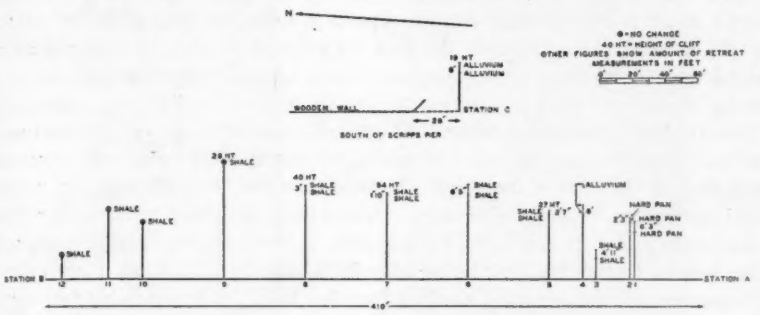

FIGURE 1.—*Measurements of sea cliffs near Scripps Institution*
For locations *see* Figure 3 of Plate 4.

photographs one can see the same concretions in the sandstone as were there at the earlier date. One large boulder-like concretion has been shifted but has not yet been carried over the edge of the cliff. The rock is firm, but waves converge on both sides of the cove and rise to considerable heights during winter storms when the swells are coming from the northwest.

Two miles north of La Jolla, the Eocene shales, sandstones, and conglomerates have not changed appreciably in 30 years (Pl. 3, figs. 1, 2) despite the relatively soft rock. The difference in the foreground of the photographs is due to the sand fill which is a seasonal effect. The old photo was taken after a period of large swells. The outlying rocks which are part of a diabase dike running diagonal to the coast have protected the cliffs to a considerable extent. The cliff face just to the right of the canyon is north of the dike and cannot have retreated to any extent since the same crack that was visible 30 years ago is still there although considerably widened. The dike rocks in the surf look the same, and various other rocks below the cliff can be recognized in the two pictures. Other photographs, not shown here, indicate that details of the cliff base have remained unchanged and that the projecting concretions of 30 years ago are still present. On the other hand, farther south near the Scripps Institution pier some projecting shale masses have been cut back, in one instance as much as 6 feet, in the past 10 years (Fig. 1). This shale is so soft that it can be dug with one's fingernails. However, even this soft shale has retreated only at the southern end of the measured line. Four stations showed no retreat in 10 years at the northern end. To the south the waves are commonly higher than to the north (Pl. 4, fig. 3).

Photographic comparisons at the Point Fermin lighthouse, just west of the port of San Pedro (Pl. 3, figs. 3, 4), show that in 42 years the shale cliffs at this point

have undergone almost no change. Many of the rock projections of the past century can still be seen in the recent photograph. Even some of the rocks projecting up from the sea floor can be recognized. The cliffs are somewhat protected by kelp beds. Also the offlying island of Catalina protects the area from southwesterly storms, and northwest swells hit the coast diagonally so that they do not have so much of an impact as in localities farther around the point to the west. At Point Vicente which is west of Point Fermin reports of retreating rock cliffs are current, but the writers' photographs of the past 10 years show no appreciable changes. East of the Point Fermin light, however, there is an area where landslides are proceeding slowly and causing considerable trouble to the city highway commission.

North of Point Conception, where the California coast makes a large bend, changing from an east-west to a north-south direction, the ocean swells are almost invariably larger than to the south of the Point. It could therefore be anticipated that erosion would proceed more rapidly in this area. Some checks have been made of the erosion in the vicinity of Port San Luis 50 miles north of Point Conception. Photographs taken here by George W. Stose before May 1898 have been retaken. Plate 4 shows a comparison on the open coast north of Port San Luis. A few outlying rocks serve as some protection in this area, and kelp beds are found outside. However, the waves must have considerable power of attack in the area as there are no outlying islands. Accordingly it is amazing to find that the details of the cliffs and of the stacks are virtually the same after approximately 50 years. Many of the rocks in the small cove in the foreground can be matched. One even gets the impression that the alluvium has undergone virtually no cutting in the half-century interval. The retreat of the alluvium insofar as waves are concerned is impeded by the underlying rock masses. Another Stose photograph south of Port San Luis showing elevated wave-cut terraces can also be matched detail for detail with no appreciable change. Possibly these cases are exceptional. If more old photographs could be found in this northern area a different story might result. On the other hand several photographs were made about 10 years ago, and some of these have been retaken showing the failure of a decade to produce significant inroad into the irregular coastal cliffs cut in moderately resistant Franciscan rocks.

The above evidence provides no data which would allow an estimate of the present rate of retreat of rocky cliffs in southern California. The cliffs show no sign of a systematic retreat. Accordingly one wonders if rates of retreat of rock cliffs have been established in other areas on thoroughly reliable evidence. Could these cases also be explained largely by collapse of caves and sea arches? Conversations and correspondence with foreign geologists suggest that some of the cliff retreats cited in the literature are based on very insecure foundations. Historical records, old sketches, and old photographs in the European area should be restudied to determine the authenticity of postulated cliff retreat in that region.

WAVE EROSION IN UNCONSOLIDATED ALLUVIUM

Cliffs consisting of Recent or Pleistocene alluvial formations along the California coast have a very different history from the cliffs consisting of solid rock. The most complete record of erosion has been kept at the Scripps Institution. At the begin-

FIGURE 1. VIEW OF EOCENE SHALE AND SANDSTONE CLIFFS NORTH OF SCRIPPS INSTITUTION
Taken about 1916. The lack of sand under the cliffs indicates that the picture was taken after a period of heavy surf.

FIGURE 2. VIEW FROM THE SAME SPOT AS FIGURE 1
Taken in November, 1945. Note that numerous outlying rocks can be matched in the two photos, and that the crack in the cliff to the right of the canyon has widened, but the block has survived 30 years of weathering. The sand cover in the foreground typefies periods of small surf. (Photo by U. S. Grant IV.)

FIGURE 3. SEA CLIFFS AT POINT FERMIN, WEST OF SAN PEDRO
Taken in 1898

FIGURE 4. VIEW FROM SAME SPOT
Taken in 1940. Note that the cliffs show little sign of change, and the rocks beneath the cliff can be matched in some places. (Photo by U. S. Grant IV.)

RELATIVELY STABLE HIGH CLIFFS NEAR LA JOLLA AND AT POINT FERMIN

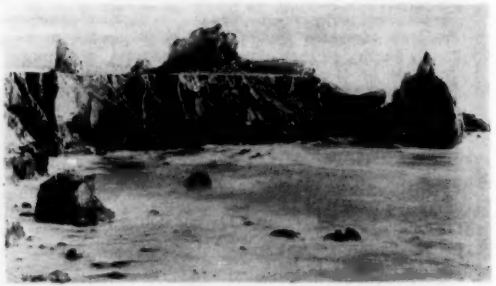

FIGURE 1. SEA CLIFF NORTH OF PORT SAN LUIS
Taken prior to 1898. (Photo by George W. Stose.)

FIGURE 2. VIEW FROM SAME SPOT
Retaken in 1945. Note the almost complete absence of change during the interim. Numerous rocks can be matched in the two photographs. (Photo by U. S. Grant IV.)

FIGURE 3. AIR VIEW OF THE SEA COAST IN THE VICINITY OF SCRIPPS INSTITUTION
"A," "B" and "C" refer to positions on the map of Figure 1. Note the variation in width of the surf zone along the coast and the small breakers inside the reef shown to the left of "B." (Official photograph of U. S. Navy, 1945.)

FIGURE 4. UNDERMINING OF THE ALLUVIAL SEA CLIFFS AT SANDYLAND BY LARGE WAVES IN 1936.
(Photo by U. S. Grant IV.)

ning of the record the recession of the recent alluvial cliffs north and south of the Institution proceeded at the rate of 1.5 feet per year for a period of 11 years; during the next 7 years the retreat was cut down to 1.0 foot per year, and in the past 10 years it has been reduced again to about 0.6 foot per year. An exact survey was made in 1936 and was remeasured using the same bench marks for the extreme ends of the line (Fig. 1). Unfortunately not many points on the alluvium were measured previously, but each of the three stations measured shows approximately 6 feet of erosion. The waves attack the cliff only at high tide and only after the winter storms have cut away the beach berm which is built out in front of the cliffs every summer. Erosion of the cliffs is facilitated by the burrows of rodents; the burrows are greatly enlarged during heavy rains and develop sizable openings on the cliff faces.

The retreat of the alluvium north of the Scripps Institution is also shown in a photographic record (Pl. 5, figs. 1, 2). Here the cliff has been lowered as it has retreated into a valley. The scale in Figure 2 of Plate 5 will give some idea of the 32-year retreat. Also the position of the cliff is indicated by the white line in Figure 1 of Plate 5. Pictures taken at intermediate dates reveal the authenticity of this comparison. The elongate pipelike concretions on the beach can be seen in both photographs although they were partly hidden in the early picture. It will be noted that the end of one concretion has been broken off and removed.

Another example of erosion in alluvial material is illustrated in Figures 3 and 4 of Plate 5 which show the rapid retreat of the low sea cliffs at Coronado. This erosion was produced by large waves, but an underlying cause may have been the building of the Zuninga (or San Diego) jetty at the west end of North Island. This jetty of rubble-stone construction was built by the Federal government to facilitate natural scour of the bar at the entrance of San Diego Bay. Construction began in October 1893 and continued intermittently until its completion in July 1904. The final length was 7500 feet, and its seaward end was in a depth of 30 feet of water. According to data obtained during a study of beach erosion at Coronado by Colonel C. T. Leeds, the jetty first produced beach erosion along North Island. As the jetty lengthened, this erosion made its effect apparent progressively eastward until in 1905 wave attack during winter storms, particularly in March, produced the disastrous effects shown in Figures 3 and 4 of Plate 5.

A recent series of large waves at Sandyland, 10 miles east of Santa Barbara, eroded low alluvial cliffs and undermined houses at the point shown in figure 4 of plate 4. The damage seems to have been due in large part to the Santa Barbara breakwater which depleted the supply of sand which was previously drifting along the coast. The net result was the removal of the sand beach from in front of the cliffs, allowing cliff erosion.

The retreat of alluvial cliffs in southern California can be matched in numerous other areas. Probably the bulk of the instances of cliff retreat listed by Johnson (1919, p. 65–72) are examples of retreat in unconsolidated formations. The U. S. Coast and Geodetic Survey measured the retreat on the exposed outer coast of Cape Cod in glacial outwash deposits and found that for 40 years it averaged 3.2 feet per year (Johnson, 1925, p. 400). At Winthrop Head, Boston Harbor, the retreat in 48 years has averaged 9 inches per year and about the same at Grover's Cliff (John-

son, 1925, p. 400). All these cliffs are from 50 to 100 feet high. Rates of 5 or 6 feet per year are reported from glacial-till cliffs of Lake Michigan (Johnson, 1925, p. 405). Unfortunately some of these studies of cliff retreat date back to the last century, and it is difficult to check their reliability.

CONCLUSIONS

Investigations, largely by comparing old photographs, have shown that erosion of rock cliffs in southern California has been negligible during the last few decades. This slight erosion contrasts strangely with indications of extensive erosion during the past few thousand years. The contrast may be explained partly by a decreasing rate as the cliffs retreat and terraces beneath the cliffs grow wider. This may be of fundamental importance. Possibly waves are not so large along this coast as was formerly the case. A third possibility is that significant erosion takes place on rare occasions, and there has been no such occasion since the old photographs were taken.

Erosion of the unconsolidated alluvium has, unlike the rock, proceeded with considerable regularity. The measurements at Scripps Institution, however, show that the rate has been decreasing although there is no evidence to show that this decrease is not related to decreasing wave height. A retreat of a foot a year appears to be common in southern California and is probably exceeded in other areas where waves are larger.

The evidence from southern California suggests that the danger of coast erosion in areas of rock cliffs may not be great, but that rapid erosion can be anticipated where no appreciable beaches front cliffs of alluvium. Studies in other areas are desirable before these conclusions should be applied too widely.

REFERENCES CITED

Brown, C. W. (1939) *Hurricanes and shoreline changes in Rhode Island*, Geog. Rev., vol. 29, no. 3, p. 416–430.

Daly, R. A. (1920) *A recent worldwide sinking of ocean-level*, Geol. Mag., vol. LVII, p. 246–261.

Emery, K. O. (1941) *Rate of surface retreat of sea cliffs based on dated inscriptions*, Science, vol. 93, p. 617–618.

Johnson, D. W. (1919) *Shore processes and shoreline development*, John Wiley & Sons.

——— (1925) *New England Acadian shoreline*, John Wiley & Sons.

Munk, W. H. (1947) *Refraction of ocean waves*, Jour. Geol., vol. LV, p. 1–26.

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Contribution from the Scripps Institution of Oceanography. New Series, No. 333.

FIGURE 1. PHOTOGRAPH OF THE SEA CLIFFS AT SCRIPPS INSTITUTION TAKEN IN 1913
The white line shows the approximate position of the present cliffs.

FIGURE 2. PHOTOGRAPH FROM THE SAME LOCATION IN 1945
Note that the sea walls do not protect the alluvial cliffs in the foreground. Scale given in feet.

FIGURE 3. STORM WAVES ACTIVELY ERODING ALLUVIAL CLIFFS AT CORONADO
The Coronado Hotel shown in the background. (Photo taken on February 6, 1905.)

FIGURE 4. PHOTOGRAPH OF SAME AREA TAKEN MARCH 17, 1905 AFTER SEVERE STORMS
Note that the road in front of the houses had almost completely disappeared.

RETREAT OF ALLUVIAL SEA CLIFFS IN SAN DIEGO COUNTY

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FOSSIL BISON AND ASSOCIATED ARTIFACTS FROM PLAINVIEW, TEXAS

BY E. H. SELLARDS, GLEN L. EVANS, AND GRAYSON E. MEADE
(With description of artifacts by ALEX D. KRIEGER)

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ABSTRACT

A quarry containing fossil bison and associated artifacts was discovered on the High Plains of northwest Texas in 1944 and excavated in 1945. The bone bed, ranging in thickness from a few inches to 1½ feet, is in a former stream channel at the base of valley fill. At the top of the bone bed the bones are more or less broken while at lower levels and at the bottom the bones are usually complete and often in articulation. Whole skeletons are preserved but are difficult or impossible to separate from associated skeletons. Excavation of 62 running feet (about 500 square feet) of the bone bed yielded parts of skeletons of 100 bison (estimated), together with 26 artifacts. The associated projectile points bear some resemblance to Folsom and Yuma types but are distinctive from both and have been described as Plainview points. The bison is notably larger than the largest individuals of the modern species and is referred to *Bison taylori*. The only other vertebrate fossil found in the bone bed is a wolf, but near-by localities in the same horizon have yielded *Parelephas columbi* and *Equus* sp. Fresh-water in vertebrates of several species are abundant in the bison bone bed and in the same horizon at other exposures in the vicinity.

INTRODUCTION

The geologist whose work is with the later Pleistocene and earlier Recent terrestrial deposits in areas outside of those affected by Wisconsin glaciation must lean heavily upon the evidence of vertebrate fossils for age determinations. However, unlike those who may be concerned with broader time divisions, he does not always find recognizable osteological differences within a given species, as the time interval spanning the late Pleistocene and early Recent is too short to expect marked evolutionary changes. Nor can he depend upon the theory of contemporaneous, continent-wide extinction of the Pleistocene fauna to serve as a marker between the two periods of the Quaternary, as the time of extinction may have differed appreciably in different areas and among the different species. A promising line of fossil evidence which merits more attention than it heretofore has received is a more accurate determination of the time of introduction by migration of new elements in the fauna of an area. Such introductions occur with relative suddenness and hence, when well understood, serve as reliable time markers. Of prime importance in this connection is the introduction of human culture and its subsequent modification and indigenous development. As these cultures and their relationships to each other and to associated faunas become better known, they become useful to the geologist as "index fossils". Although the study of these human cultures is in the province of archaeology, the full interpretation of cultural assemblages found under conditions implying geologic antiquity requires the employment of geologic methods. Both geology and archaeology benefit from the solution of the problems of early man, and these problems are best approached by the combined efforts of geologists and archaeologists. The study here recorded includes observations of representatives of these two sciences.

During the summer of 1944 Glen Evans and Grayson Meade, while studying the Pleistocene geology of the Texas High Plains for the Bureau of Economic Geology of The University of Texas, discovered a fossil bone bed exposed in a pit made for road materials near Plainview in Hale County, Texas. It was not practicable to excavate

the bone bed during 1944. From June to October, 1945, the greater part of the bone bed was excavated. Engaged in the excavation were Glen Evans, Grayson Meade, Richmond Bronaugh, Alex Krieger, Adolph Witte, and E. H. Sellards. Dr. Clarence Webb and Clarence Webb, Jr., of Shreveport, Louisiana, visited the locality in

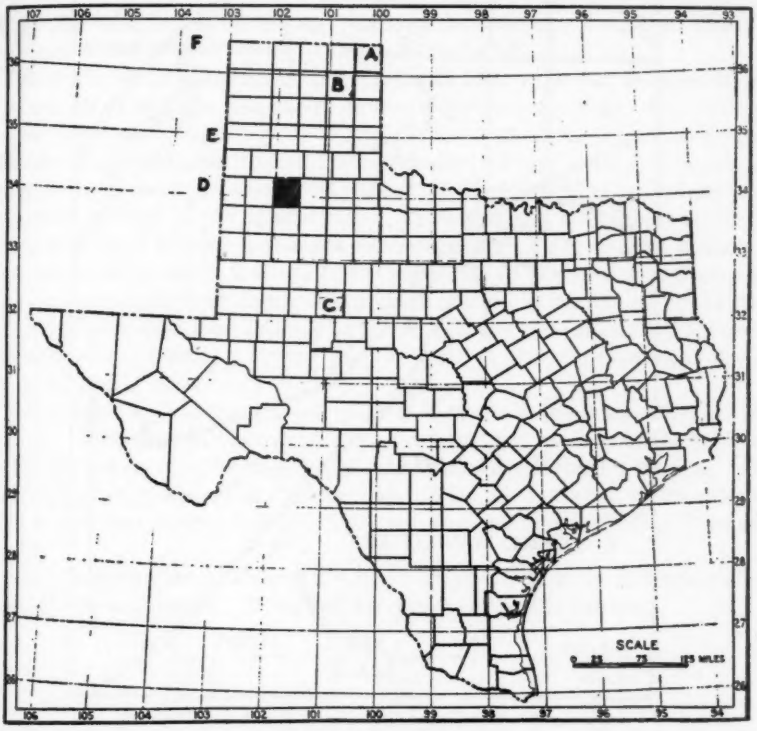

FIGURE 1.—*Index map of Texas*

Hale County indicated by shading. Other localities in this region where artifacts have been found in association with extinct animals under conditions comparable to those at the Plainview locality: A, Lipscomb County (Schultz, 1943); B, Roberts County (Sellards, 1938); C, Mitchell County (Cook, 1927); D, Clovis, New Mexico (Howard, 1935); E, San Jon, New Mexico (Roberts, 1942); F, Folsom, New Mexico (Figgins, 1927).

July 1945 and aided in excavating. These investigations, made jointly by the Bureau of Economic Geology of The University of Texas and the Texas Memorial Museum, are part of a larger project for the study of Pleistocene geology. Acknowledgment is made by these organizations for courtesies extended by the officialsand citizens of Plainview and by the owners of the land on which the pit is located.

THE BONE BED

The road-material pit, opened in 1933 and worked intermittently since that time, is located on the south margin of the valley of Running Water Creek, one of the

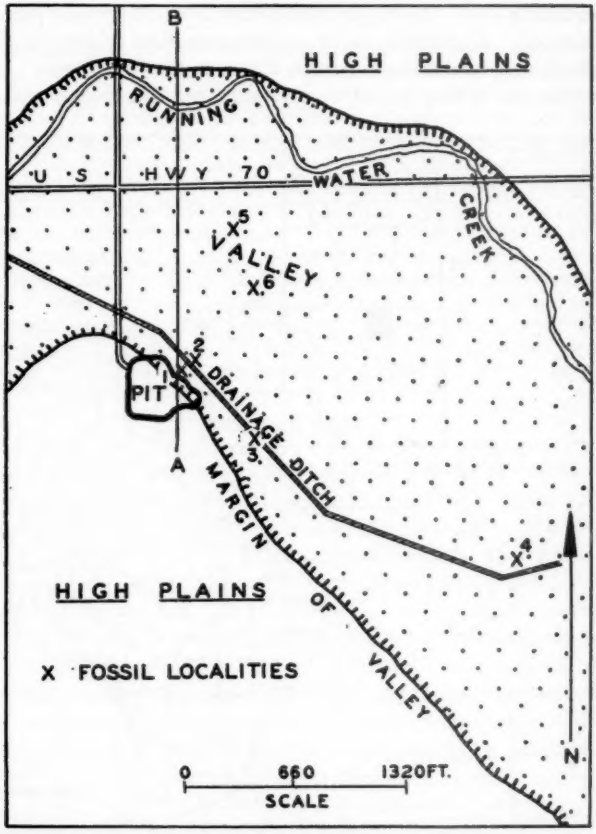

FIGURE 2.—*Sketch map of the valley of Running Water Creek*
At Plainview; fossil localities as follows: 1, the bison quarry; 2, location of scraper and elephant tooth in place at the side of the drainage ditch; 3, elephant skeleton; 4, horse; 5, elephant; 6, elephant and horse.

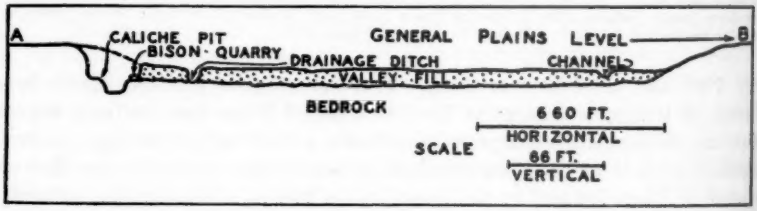

FIGURE 3—*Cross section of valley of Running Water Creek*
On line A-B of map of valley.

headwater tributaries of Brazos River. The road material utilized is caliche and calcareous clays from the Panhandle formation. This formation, which includes

strata of Pliocene and early Pleistocene age, underlies most of the Texas High Plains and is the bedrock on which the valley fill of Running Water Creek is resting. When the pit was being extended northward into Running Water Creek Valley to obtain caliche underlying the valley fill, the bison bones were exposed. The bison bone bed thus had been uncovered, and a small part of it removed while excavating for road material, but it was not reported until discovered by Evans and Meade in the summer of 1944.

The length of the bone bed as excavated is 62 feet. The width ranges from a maximum of 10 feet near the middle to 5 or 6 feet near the ends. The thickness ranges from a few inches near the margins to about 18 inches in the central part. The total excavated area is about 500 square feet. Many teeth, foot bones, and metapodials were well preserved in all parts of the deposit, but the larger bones were well preserved only in the thicker parts. Eight blocks of bones showing the full thickness of the bone bed were taken from the quarry. The location of three of these, marked 1, 2, and 3 , is shown on the plat (Fig. 4). Over most of its area the bone bed rested directly on caliche bedrock, but near the upstream and downstream ends it was separated from bedrock by a few inches of the valley fill. The bones evidently accumulated in a stream channel which at this place impinged against the south valley bluff.

The location of 21 artifacts found in place in the bone bed is shown on the plat (Fig. 4). Five other artifacts were displaced from their position in the bone bed during the process of excavation; hence their exact location cannot be given. One additional artifact, a small end scraper (Pl . 5, fig. 4), was found in the drainage ditch at the same horizon and within 25 feet of an elephant tooth (Fig. 2, locality no. 2)[1].

All artifacts illustrated on Plates 3, 4, and 5 are contained in the collections of the Texas Memorial Museum. They bear catalogue numbers as follows:

Plate 3	
Fig.	*Cat. No.*
1	725-10
2	725-23
3	725-4
4	725-11
5	725-6
6	725-13
7	725-19
8	725-7

Plate 4	
Fig.	*Cat. No.*
1	725-2
2	725-9
3	725-8
4	725-16
5	725-18
6	725-14
7	725-12
8	725-15
9	725-24

Plate 5	
Fig.	*Cat. No.*
1	725-5
2	725-22
3	725-1
4	733
5	725-20
6	725-3
7	725-17

The following three artifacts from this locality are not illustrated in this paper: one side scraper, 725–21; one broken point remaining in place in block of bones, no. 725–25; and one broken point remaining in place in block of bones presented to Texas Technological College. The drawings for the illustrations have been made by Jean Baker Sandidge.

[1] In January 1947 after the manuscript had been written, Mr. Guy Whitacre of Plainview, Texas, kindly lent the writers a Plainview projectile point which was found by his son, Mr. Val Keene Whitacre, about January 1941. Mr. Whitacre stated that the point was found near the exposed margin of the bison quarry and that it was partially embedded in a piece of bone when discovered. Unfortunately the bone has since disintegrated and fallen free from the point. This point is shown in Figure 5. The total number of artifacts found with the bones, including this point, is 27.

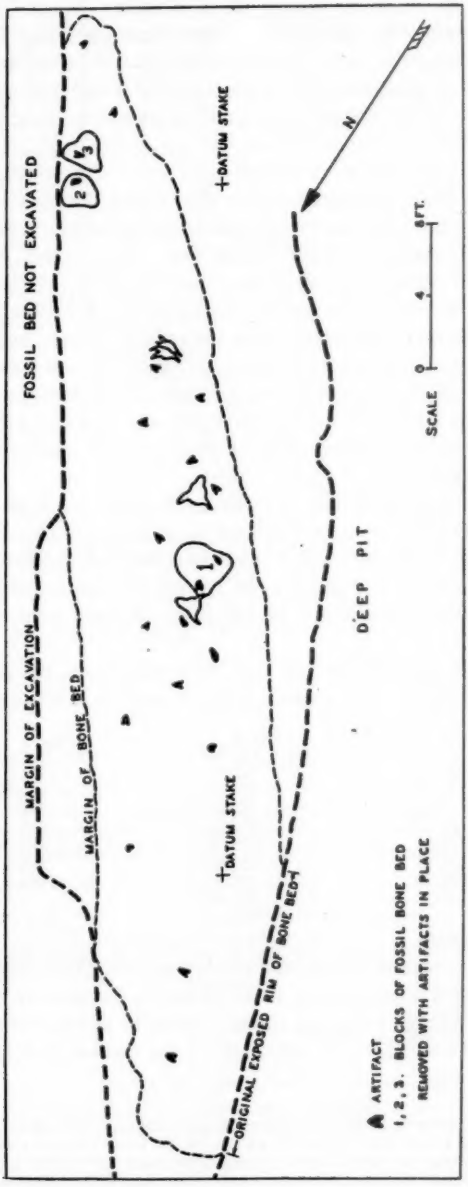

FIGURE 4—*Plat of the bison quarry*

TABLE 1.—*Skull measurements in millimeters*

	Plainview Bison		*Bison taylori* type	*B. taylori* Hopper Ranch	*Bison occidentalis* from Kansas	Ten skulls of Modern Bison		
	725-26	725-27				*Max.*	*Min.*	*Average*
Maximum length of skull	625	570*	598	635		562	543	†
Width of forehead between bases of horn cores	380	....	436			316	256	286.7
Width at narrowest point between horn cores and eye sockets	330	298	392			287	246	269.4
Length from foramen magnum to top of occipital	130					113	85	97.7
Distance between tips of horn cores	875	725	980	960	875	653	532	594.5
Length of horn cores along upper curvature	305				318	219	160	187.0
Circumference of horn cores at base	357				343	277	230	244.5
Dorso-ventral diameter of horn cores	113				108	84	69	76.5
Antero-posterior diameter of horn cores	104				108	86	74	78.9

TABLE 2.—*Measurement of length of scapula and longer leg bones in millimeters*

	Plainview Bison	Modern Bison	Clovis Bison(From Stock and Bode, 1936, p. 239)
Scapula	608	488.5	
Humerus	393 (Av. of 4)	360 (Av. of 6)	
Radius	364.5 (Av. of 2)	328 (Av. of 3)	
Metacarpal	221.5 (Av. of 16)	200	217.0 (Av. of 11)
Femur	454	413 (Av. of 2)	
Tibia	457	413 (Av. of 2)	
Metatarsal	264 (Av. of 10)	251 (Av. of 2)	263.8 (Av. of 8)

* Skull of a young animal, permanent teeth beginning to replace deciduous teeth.
† Only two skulls available for this measurement.

THE BISON

The quantity of bison bones removed from the quarry is large, and preparation for study has proceeded slowly. Measurements are available of the skull of one mature individual (no. 725–26) and partial measurements of the skull of one immature animal (no. 725-27). The following comparative measurements of *Bison taylori* from the type material are from Hay and Cook (1930, p. 28). Those from the Hopper ranch, Texas, are from Schultz (1943, p.247). Those of *B. occidentalis* are from the Kansas skull (not the type specimen) as given by Lucas (1899, p. 758). Ten modern bison skulls were measured, but, to conserve space, only maximum, minimum, and average measurements are given.

From the measurements given, the Plainview bison is much larger than the modern

bison or American buffalo. The mature skull now available for measurement is comparable in size to *Bison taylori*, the type specimen of which is from Folsom, New Mexico (Hay and Cook, 1928), or to the skull of a bison found in Logan County, Kansas, and referred to *Bison occidentalis* (Lucas, 1899). The type specimen of *B. occidentalis* is from Alaska and is somewhat smaller. The Plainview fossil is identified provisionally as *Bison taylori*.

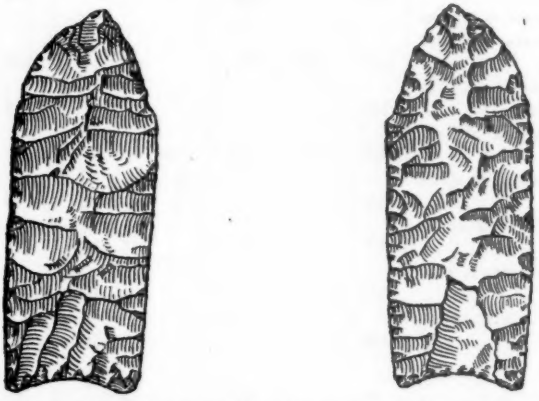

FIGURE 5—*Plainview point found partially embedded in bone*
Natural size.

ACCUMULATION OF BISON BONES AND ARTIFACTS

The bone bed at the Plainview locality is a mat of closely spaced, disarticulated bones and skeletons. Skeletons and partial skeletons of approximately 100 bison were found in an area of about 500 square feet; the bone bed has an average thickness of scarcely a foot. The manner of accumulation of so many bison in a limited space presents an interesting question.

The bones evidently accumulated in a shallow water hole or pond within a former channel of Running Water Creek. That the water was shallow is indicated by the thin layer of pond sediment with broken and poorly preserved bones in the upper part and by the presence of abundant fresh-water invertebrates, concerning which Dr. Horace G. Richards writes (February 4, 1946) as follows: "The *Lymnaea, Physa, Helisoma* species are all pulmonates and are usually found living in shallow water pools and ponds." The bones accumulated either all at one time or within a short period of time, as proven by the homogeneous character of the bone bed, which contains no separating layers of sediments. Had the accumulation taken place over a relatively long period of time, the bone bed would almost surely have been divided by successive layers of stream sediments, as it occupies a position in the channel bottom which would have been flooded at relatively frequent intervals. The accumulation took place at least in part during the spring or early summer, as indicated by the several fetal skeletons which, judging from their size, must have

been nearing the time of birth. The bison did not mire in the pond sediments, as the limb bones were found lying in a horizontal position.

The associated artifacts, which constitute the only direct line of evidence bearing on the manner of accumulation, prove that man was at least a contributing factor. However, it seems improbable that man could have killed so many bison within the small area of the bone bed in the short period of time indicated.

On the basis of these observations one may entertain several hypotheses as to the causes of the accumulation of so many skeletons. One such hypothesis is a bison stampede[2].

At the location of the bone bed the channel impinged against the valley wall, and hence there was probably a low, steep bluff bordering the south side of the water hole. Stampeding bison attempting to cross the stream at this point might easily have fallen in descending the bluff and become trampled by the remainder of the herd.

Implements found with the bones show that man was a skilled implement maker, probably a skilled hunter, and, like the modern Indians, quite capable of planning and carrying out a bison stampede for his own benefit. There is no evidence to indicate whether the projectile points were shot into the bison prior to, during, or subsequent to such a stampede. However, the presence of the projectile points in the upper half of the bone bed may indicate that they were shot into those bison at the top of the pile which were crippled or attempting to extricate themselves. Probably only those bison at the top of the pile could have been utilized, which may account for the scrapers also being found in the upper half of the bone bed.

An alternate hypothesis for the accumulation of so many bones in such a small area is that the bison skeletons may have accumulated gradually over a period of several months or even several years.[3] A gradual accumulation would also have had to take place during a dry interval when the stream did not flow enough to carry layers of sediment into the pond. During such an interval, or even during a severe drought, scattered water holes, such as the Plainview locality may represent, would have been regularly frequented by the bison and so would have provided an ideal stalking ground for hunters. The presence of the several dart points among the bones in the upper part of the fossil bed requires the explanation that man killed at least some of the bison. The slain animals, possibly individuals already weakened by natural causes or by man's darts, may have been dispatched on the spot or were severely wounded in the near vicinity and came to the pond to die. The fetal material which was frequently encountered in the bison bone bed suggests, under this hypothesis, the possibility that gravid females were easy game for the hunters.

[2] The chronicler of Coronado's expedition (1540–1542), Castaneda, records an incident of a stampede of modern bison that is suggestive of what may have happened from time to time on the Plains. Speaking of one of the many great herds of bison seen on the High Plains, he relates that in one instance, when the bison were frightened, "As they fled, they trampled one another in their haste until they came to a ravine. So many of the animals fell into this that they filled it up, and the rest went across on top of them." (Winship, 1896, p. 505.)

Darwin (1890, p. 142) described from the report of an eyewitness the behavior of cattle during the "great drought" on the Pampas of South America, 1827–1830. "Cattle," he says, "in herds of thousands rushed into the Parana, and being exhausted by hunger, were unable to crawl up the muddy banks, and thus were destroyed." Wild horses of the Pampas, likewise, under the influence of great thirst, have been observed, according to Azara, as quoted by Darwin, "rushing into the marshes, those which arrived first being overwhelmed and crushed by those which followed."

[3] Darwin (1890) observed on the South American Pampas that the smaller streams in the Pampas were "paved with a breccia of bones," and concludes that "this probably is the effect of a gradual increase, rather than the destruction of any one period."

GEOLOGIC CONDITIONS

HIGH PLAINS SOUTH OF CANADIAN RIVER

The High Plains south of Canadian River constitute an isolated tableland known as the Staked Plains or the Llano Estacado. This tableland, lying in western Texas and eastern New Mexico, is a remnant of a great alluvial plain that continued at one time westward to the Rocky Mountains. In Texas, it slopes southeastward at an average rate of 7 to 10 feet per mile.

Running Water Creek, an intermittent stream, originates on the Llano Estacado in eastern New Mexico and flows southeastward past Plainview, Texas. The valley is entrenched 20 to 40 feet below the plains level and has an average width of between a quarter and half a mile. The floor of the valley, across the Texas plains, is covered by 10 to 12 feet of alluvial fill. On this fill the present Running Water Creek maintains only a feeble channel 2 to 4 feet deep along parts of its course; other parts are unchanneled.

This valley fill is exposed at Plainview in the bison quarry, in the several sand and caliche gravel pits near by, and along the drainage canal which was constructed to facilitate the flow of water, following heavy rains, past the city of Plainview. The fill consists of a basal zone of cross-bedded sands and water-worn caliche gravels from a few inches to 3.5 feet thick, an intermediate zone of massive, compact, sandy clay 5 to 8 feet thick, and an upper zone of dark sandy soil 1.5 to 3 feet thick. The basal zone, which contains the bison bone bed, was evidently deposited when the stream was much more active than at present. The intermediate zone, which overlies the bison bone bed, is flood-plain deposits in part contemporaneous with the basal channel gravels. The upper zone has formed since the valley reached an essentially graded condition and represents a very slow accumulation.

FOSSILS IN THE STREAM DEPOSIT

Both vertebrate and invertebrate fossils occur in the basal and intermediate zones of the valley deposits of Running Water Creek at Plainview. The first vertebrate fossils reported from here are remains of *Parelephas columbi* and *Equus* sp.[4] collected by Captain Winfield Holbrook of Plainview, Texas, and sent to the Bureau of Economic Geology in February 1922. In 1928 Mr. B. T. Wells of Plainview, Texas, collected fragments of elephant limb bones and a tooth of *Parelephas columbi* from these deposits (locality no. 5, Fig. 2). The writers have also found both elephant and horse at several localities at the base of the valley fill (Fig. 2).[5]

Excavation of the quarry in 1945 yielded the bison, artifacts, and fragmentary parts of a wolf, including 3 canines, lower premolars 3 and 4, and a lower carnassial (Fig. 6). The teeth agree closely in size and structure with the corresponding teeth of *Canis occidentalis* and are referred to that species.

The vertebrate fauna from the valley-fill deposits at Plainview consists of the following: *Bison taylori*, *Parelephas columbi*, *Equus* sp., *Canis* cf. *occidentalis*, and

[4] Identified by Sellards, letter of May 16, 1922.

[5] In November 1946 an additional site (locality no. 3) for vertebrate fossils was found at the side of the drainage canal. This place has yielded a partial elephant skeleton, *Parelephas columbi*, which includes the mandible, skull fragments, teeth, one tusk, three limb bones, pelvis, and numerous ribs.

man, represented by artifacts. Of these, the bison, elephant, and the horse are extinct species.

The invertebrates, identified by Doctor Horace G. Richards, include the following: *Lymnaea humilis* Say, *Lymnaea palustris* Muller, *Physa halei* Lamarck, *Helisoma*

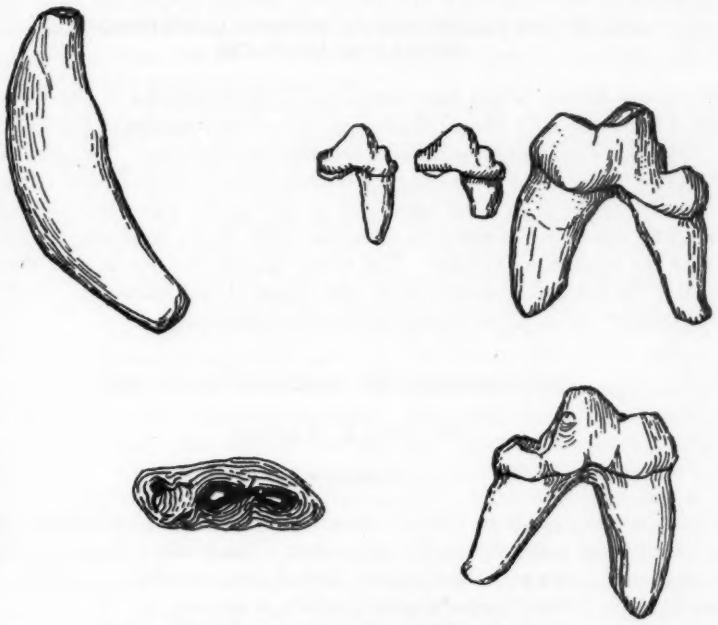

FIGURE 6—*Teeth of the wolf, Canis* cf. *occidentalis*

Canine; premolars 3 and 4, and first molar (carnassial) of the left lower jaw; and superior and inner views of left lower carnassial. Natural size.

trivolvis Say, *Sphaerium sulcatum* Lamarck, *Pupa* sp. In contrast to the vertebrates, all invertebrates, Doctor Richards believes, are identical with existing species.

That the invertebrate species should be identical with living forms while the vertebrates are mostly extinct is not unexpected, as similar conditions exist elsewhere. From stratum no. 2 of the section at Vero, Florida, 28 species of land and fresh-water invertebrates were obtained, all of which, as identified by Dr. Paul Bartsch, are still living. Of 21 mammalian species, additional to human relics, found in place in the same formation, at least 13 are extinct (Sellards, 1916, p. 158). In the marine Anastasia formation, which at the same place underlies and is older than stratum no. 2, most of the invertebrates are species still living.

COMPARISON OF PLAINVIEW WITH SOME OTHER SIMILAR LOCALITIES

Krieger lists various localities where projectile points somewhat like those at Plainview have been found. Of the localities listed, the surface finds offer no information as to geologic age and hence will not be discussed in this connection. There

are, however, several localities where similar points have been found under conditions which are comparable in stratigraphic, cultural, geologic, or paleontologic conditions to the Plainview locality. Reference to certain of these localities is given in Table 3.

AGE OF THE VALLEY-STREAM DEPOSITS CONTAINING THE FOSSILS AND ARTIFACTS

Evans and Meade (1945) have recognized three formations in the Pleistocene series of the Texas High Plains: the Blanco (heretofore regarded as Pliocene), Tule, and Tahoka. Each formation includes extensive lake deposits. The older deposits of Running Water Creek containing the bison bone bed and associated artifacts are tentatively correlated with the upper part of the Tahoka (late Pleistocene) formation. This correlation is based on abundant bison of the same species that characterize the uppermost Tahoka. This bison appears to have been a diagnostic species of the Tahoka, especially of the later stages of that formation. Field work on the problem of the age of the deposits is being continued.

ARTIFACTS FROM THE PLAINVIEW BISON BED

By Alex D. Krieger

INTRODUCTION

In the preceding pages the authors compared the Plainview association of artifacts and extinct fauna with other similar discoveries. This study is limited to a description of the artifacts and a consideration of what they contribute to a better understanding of the Folsom-Yuma typology problem in general.

As is well known, there is great confusion in the definition of Folsom and Yuma dart points in that zone in which their features tend to be combined in various ways. This has been largely due to a common insistence that many somewhat similar projectile points found under conditions indicative of some geological antiquity must be classified as either Folsom or Yuma, Folsomlike or Yumalike, *etc.* This insistence has been a serious brake on the development of the Folsom-Yuma problem, but its alleviation must depend on the discovery *in situ* of artifact series sufficiently large to define distinctive types.

In this respect the Plainview artifacts are of great value. The series forms a single association, and the artifacts were used in connection with the slaughtering of bison found on the old valley floor. The series of 18 complete and fragmentary projectile points reveals consistency in pattern, as do the scrapers. Upon their discovery, the question immediately arose: Are the projectile points Folsom or Yuma? Our conferences made it quite apparent that they combine features of both and that a new name should provide a progressive step toward clarification of the so-called "Folsom-Yuma" typology problem. The name Plainview Point was agreed upon and has been used in a previous publication (Sellards, 1945).

POINTS

General statement.—Eighteen[6] dart points, of which 8 are complete or nearly so, 1 rechipped, and 9 fragmentary, have been recovered from the bison bone bed. One fragment donated to Texas Technological College, Lubbock, and another not removed from the display matrix are omitted in the descriptive table (Table 4). They would not affect the conclusions to be drawn from the other 16. One complete specimen (725–23) was also left in place for display purposes but has been sketched (Pl. 3, fig. 2) and its measurements recorded.

Material.—There is interesting variety in the materials. Four specimens are so-called "Alibates flint", an agatized dolomite found in great outcroppings near the Canadian River due north of Amarillo, Texas. This material is easily recognized by its red and yellow, red and purple, and yellow and gray bands; it breaks with conchoidal fracture, and its chipping qualities are much like those of flint. It was widely used among tribes of the southern Plains. Brown and gray-brown flints were used for other specimens and are found in the eroded basins of north-central Texas. Still other materials, such as the chocolate-brown and black flints (725–7,725–10) are common in the Edwards Plateau in central Texas, especially near Kerrville. The flints with white and pale-blue flecks (725–3, 725–5, 725–13, 725–18) are not familiar to the writer. In one case (725–6) the material is a pale orange or brownish yellow with white veins, suggesting chalcedony rather than flint. The collection as a whole clearly shows that artifact material was acquired from several different sources, either by trade or during migrations of these peoples in following the bison. No specimen shows patination. "Alibates flint" is said never to patinate, but the true flints do under certain conditions.

Dimensions and form.—Seven specimens reveal the length of these points. Six range from 66 to 74 mm.; the seventh (725–1) is 52 mm. plus 2–3 mm. missing at the tip. Another (725–9) is 50 mm. long, but its tip was shattered, and the remainder given a stubby new point. There is great uniformity in the base width of all specimens; the bases present range between 22 and 24 mm. Maximum width also shows a narrow range between 22 and 26 mm. The place of maximum width varies, however, between the base and a point approximately midway between base and tip. In some cases (notably 725–2, 725–3, 725–4, 725–8, 725–10, 725–12, 725–13, 725–23) the edges are almost perfectly parallel from the base forward to a point about midway from base to tip, or slightly more than midway. In five or six cases the specimen is somewhat wider at the midpoint than at the base; this is definitely true of one whole specimen (725–1) and apparently so of several fragments (725–6, 725–9, 725–11, 725–18) and the rechipped example (725–19). In each instance the maximum width at midpoint exceeds the base width by only 1–2 mm., except in (725–9) where the difference is 3 mm. One specimen (725–5) has recurved edges; the base is

[6] The Whitacre specimen (*see* Figure 5) was not included. It conforms with the type series in size, proportions, chipping, smoothing of edges from base to broadest part, and thinning of the base. The large flake scar seen on one face probably resulted from thinning the base and not from an attempt to produce a channel. The flint is uniformly light brown, not like any of the other specimens. The length is 58 mm., base width 20 mm., maximum width 22 mm., thickness 5 mm., and basal concavity 2 mm. deep. The edges are smooth for 40 mm. forward, and the tip is slightly shattered by impact.

TABLE 3.—*Comparison of Plainview and some other localities as to stratigraphic, cultural, geologic, and paleontologic conditions*

Locality	Stratigraphic Conditions	Culture	Vertebrate Fossils	Geologic Age
Plainview, Texas	Basal stratum of stream-valley fill.	Plainview points and scrapers, type locality.	*Bison taylori, Parelephas columbi, Equus* sp., *Canis* cf. *occidentalis*.	Placed tentatively as late Pleistocene.
Clovis, New Mexico	Stratified deposits, the Clovis beds, resting unconformably on sand and gravel or caliche, sand, and gravel (Sellards, 1940, p. 397).	Folsom projectile points, in place and from dump around pit. Clovis Fluted in place, type locality. Plainviewlike points in pit and from dump around pit. Scrapers and bone artifacts in place. (Howard, 1935, p. 93; Cotter, 1937, p. 13, and 1938, p. 116.)	*Bison* cf. *taylori, Equus* cf. *excelcus, Parelephas* cf. *columbi, Platygonus* sp., and *Cynomys* sp. (Stock and Bode, 1936, p. 234–239.)	Late Pleistocene or early Recent (Antevs, 1935, p. 310; Bryan and Ray, 1940, p. 71; Price, 1944, p. 407; Stock and Bode, 1936, p. 240). *See* also Bryan, F., 1938.
Fairbanks, Alaska (Goldstream and Ester Creek localities)	In frozen muck or silt, somewhat disturbed, at least superficially.	Goldstream. One projectile point resembling Plainview and two bone artifacts. Ester Creek. Several artifacts including one Plainviewlike point.	Many extinct mammalian species. Mammoth, mastodon, bison, and horse.	Referred to as late Pleistocene, the age determination being based on fauna and flora (Rainey, 1939; Cheney and Mason, 1936).
Folsom, New Mexico	Stream valley fill.	Folsom, type locality; 19 projectile points (Wormington, 1944, p. 7).	*Bison taylori*, parts of 40–50 individuals. (Brown, 1929.)	Close of Pleistocene (Brown, 1929); late Pleistocene or early Recent (Bryan, 1929, p. 129).
Lindenmeier, Colorado	Stratified deposits in stream valley.	Still higher level. True Yumas and some questionable forms. Higher level. Generalized Yuma, one of which is somewhat like Plainview. Lowest horizon. Folsom only, with one possible exception (Roberts, 1940, p. 64).	*Bison taylori* (Gazin, in Roberts, 1936, p. 17). Wolf, fox, and rabbit, all recent species (Kellogg, in Roberts, 1935, p. 32).	Late Glacial (Bryan and Ray, 1940, p. 69).
Sandia, New Mexico	Stratified deposits in cave.	Top level. Late culture and fauna. Next overlying horizon. Folsom and some unfluted points resembling Plainview points. Lowest horizon. Sandia points, type locality (Hibben, 1941).	Folsom horizon. *Bison* sp. (smaller than *B. taylori*), *Camelops* sp., *Canis* cf. *lupus, Elephas* sp., *Equus* sp. near *occidentalis, Nothrotherium* sp. (Hibben, 1941, p. 33).	Sandia horizon preceding, and Folsom horizon immediately succeeding, last Wisconsin ice advance (Bryan, 1941, p. 45).
Scottsbluff,	Bison bone bed in stream	Scottsbluff Yuma, type locality;	*Bison antiquus taylori* (Barbour	Late Pleistocene (Sellards,

Lowest horizon. Sandia points, type locality (Hibben, 1941).		(Hibben, 1941, p. 33).		
Scottsbluff, Nebraska	Bison bone bed in stream gravel deposits (Schultz and Eiseley, 1935, p. 307).	Scottsbluff Yuma, type locality; one stemmed point; one Plainviewlike point, scrapers, and others (Barbour and Schultz, 1932b, p. 283).	*Bison antiquus taylori* (Barbour and Schultz, 1936, p. 434).	Late Pleistocene (Schultz and Stout, 1945, p. 244).
San Jon, New Mexico	Stratified deposits in lake bed	San Jon point, type locality; various other artifacts at higher levels (Roberts, 1942, p. 7).	*Bison* cf. *taylori* (Gazin, in Roberts, 1942, p. 8).	Not fully determined.
Colorado, Texas	Stream valley fill, cut into by later stream.	Three projectile points, one broken. The broken point resembles Plainview points.	Extinct bison, horse, camel, and elephant.	Pleistocene (Cook, 1927).
Cowan ranch, Texas	Filled solution basin.	Three Clovis Fluted points, one scraper.	*Parelephas columbi* (Sellards, 1938).	Not fully determined.
Lipscomb County, Texas	Filled basin?.	Folsom points and scrapers.	*Bison antiquus taylori* (Schultz, 1943, p. 247).	Not fully determined.
Linger site, Colorado	Blow out in sand dune.	Folsom points and scrapers and some other points (Hurst, 1943)	*Bison* cf. *taylori* (Granger and Simpson, in Hurst, 1943).	Not fully determined.

24 mm. wide, the edges contract in a shallow curve to a width of 22.5 mm. and expand again to a width of 26 mm. at a point 40 mm. from the base. In this example the recurve may have been due to more intensive grinding or smoothing of the edges. The length is consistently three to four times the base width.

In all cases where present, the base is concave and varies in depth from 1 to 3.5 mm., usually being 2 mm. The concavity is recurved, rounding into the base corners rather than meeting them sharply.

Thickness varies from 4.5 to 7 mm. The point of greatest thickness is usually midway between the ends, but where a ridge is present the thickness is uniform from midpoint nearly to the tip. Cross sections are shown in the plates.

Two distinct variations may be seen in the form of the projectile tip. In three cases (725–4, 725–7, 725–12) this is long (about 47 to 50 mm.) and slim with fairly straight edges; in the first two there is collateral chipping with a well-defined ridge. On 10 specimens the tip is notably shorter, ranging from 18 to about 33 mm., with convex edges. A larger series might reveal such consistency in these two tip forms that a subdivision into distinct projectile types would be justified, but for the present they appear to be variations within the Plainview Point type.

Smoothed edges.—Of the 16 specimens under discussion, all but one (725–1) have smooth edges extending from the base forward to midpoint or to where the edges begin converging toward the tip. The smoothing or grinding, presumably connected with haftment, often provides a line of demarcation between the proximal and distal halves of the projectile point. It may be said to mark the stem, although no distinct shoulders are present.

Flaking.—Two forms of flaking are present. One is irregular with the flake scars distributed over the convex surfaces. The other is collateral with flakes of roughly equal size being removed from both sides of a medial ridge on one or both faces. One or two examples are intermediate, a faint ridge being present, but the collateral work (if it were intended) was not skillfully done. In one case (725–10) "ripple flaking" of parallel scars completely crossing the specimen occurs on both faces of the proximal end, while the distal end bears low ridges with crudely collateral flaking. Collateral flaking occurs both with long, slim tips and shorter, rounded tips.

Two specimens (725–1, 725–2) have what may be bevels along the edges of one face. On the first, these extend from near the base to the tip, and the central portion is a large flat flake scar; it therefore appears that the steep edges were not actually beveled but resulted from attempts to straighten a conchoidal surface. In the second case, the "bevel" is confined to the pointed end and likewise seems to have resulted from an attempt to straighten the artifact. In both instances the reverse side is convex and chipped in the usual fashion.

In one case (725–9) the point was shattered and probably rechipped into a shorter, stubby tip. One specimen (725–12) has very fine edge retouching extending all around the part recovered. The remaining specimens are well made but in general lack this fine edgework. There are no examples of fluting. Two or three short scars extend forward from the base concavity in some cases, but these appear to have been for thinning the base only. Of nine fragmentary specimens, only one is definitely the basal portion, six are the distal end, and two are indeterminate.

TABLE 4.—*Plainview projectile points*
(measurements in millimeters)

Catalog number	Pl. number	Material	Total length	Length of tip (approx.)	Base width	Maximum width	Depth of base concavity	Thickness	Medial ridge with collateral chipping	Remarks
725-1	5—3	"Alibates flint"	52+	(20)	22	24	2	6	no	Crude bevels (?) along both edges of one face; basal edges not smoothed
725-2	4—1	"Alibates flint"	67+	(33)	24	25	2	6	no	Bevels (?) on both edges of one face at pointed end
725-3	5—6	Light-brown flint with numerous white flecks	?	(23)	?	22	?	7	no	Fairly definite medial ridge on one face but chipping irregular
725-4	3—3	"Alibates flint"	74+	49	23	23	2	7	yes	Good collateral chipping on forward half, both faces; basal end thinned with longitudinal scars
725-5	5—1	Brown flint with pale-blue flecks	69	30	24	26	1	6	no	Width 22.5 between base and shoulder
725-6	3—5	Orange-yellow veined flint or chalcedony	?	25	?	23	?	5	no	
725-7	3—8	Chocolate-brown flint, lustrous	?	(47)	?	(23)	?	6	yes	Chipping very regular, scars 2-4 mm. wide
725-8	4—3	Gray-brown flint	73	(28)	(23)	(23)	2	6.5	no	Chipping faintly collateral on one face only
725-9	4—2	Dull-brown flint	(50)	?	23	26	2	4.5	no	Tip probably shattered and rechipped
725-10	3—1	Black flint	71	27	22	22	3.5	6.5	yes	Low ridge, crude collateral chipping on forward end; crude ripple flaking crosses lower end on both faces
725-11	3—4	Dull orange-brown flint	?	25	?	22	?	5.5	yes	Low ridge on both faces, but regularly collateral chipping
725-12	4—7	Lustrous gray-brown flint	?	(50)	(22)	22	?	6	no	Very fine edge retouching; base missing

TABLE 4—*Continued*

Catalog number	Pl. number	Material	Total length	Length of tip (approx.)	Base width	Maximum width	Depth of base concavity	Thickness	Medial ridge with collateral chipping	Remarks
725-13	3—6	Lustrous gray-brown flint with white and blue flecks	?	?	22	(24)	3	5.5	?	Basal fragment
725-18	4—5	Light-brown flint with white flecks	?	(33)	?	23	?	5.5	?	Tip shattered; base missing
725-19	3—7	Lustrous gray-brown flint	?	?	22	(23)	1	5	?	Point shattered, slightly rechipped
725-23*	3—2	"Alibates flint"	66	18	23	23	2	(6)	yes	Ridge pronounced on exposed face, other unknown

* Not removed from bone matrix.

SCRAPERS

General statement.—Eight artifacts probably used for cutting and scraping were recovered from the bone bed. A snub-nosed end scraper (733) was found in the old valley fill near by. Of the nine artifacts, two are snub-nosed end scrapers (725–15, 733), one is a thin flake with minute scars along two edges and might be termed a flake knife rather than scraper (725–14), and the other six are side scrapers or fragments thereof. No gravers or other such artifacts have been found.

Material.—The range of material is somewhat narrower than that of the projectile points, but there are fewer specimens. Six are of the light-brown and gray-brown lustrous flints which occur in quantity in the great eroded basins to the east; one is of "Alibates flint" from the Canadian Valley outcrops; one is of bluish flint like that found in parts of the Edwards Plateau; and one (733) is yellow with pale-blue flecks, a flint unknown to the writer. Again, a variety of sources is apparent.

Dimensions and form.—The size of these artifacts varies considerably, as seen in Table 5. The smallest complete one is the thin scraper or flake knife (725–14) shown in figure 6 of Plate 4. The two snub-nosed end scrapers (725–15, 733) are 48 by 33 mm. and 36 by 25 mm., respectively, the bit being the widest part in each case. Of the six side scrapers, a tiny fragment (725–16) seems to have broken from a scraper edge and may be disregarded; the other five (725–17, 725–20, 725–21, 725–22, 725–24) were made from thick spalls with conchoidal fracture surfaces and range from 51 to 101 mm. in length and 26 to 42 mm. in width. The two smaller dimensions, however, apply to a specimen from which one end was broken.

Chipping.—Although the series is small it is perhaps significant that all specimens

TABLE 5.—*Plainview scrapers*
(measurements in millimeters)

Catalog number	Pl. and fig. no.	Material	Length	Maximum width	Maximum thickness	Remarks
725-14	4—6	Light-brown lustrous flint	35	20	2	Thin pointed chip with low medial ridge and tiny scars around two long edges of one face.
725-15	4—8	Gray-brown lustrous flint	48	33	10	Well-made snub-nosed end scraper.
725-16	4—4	Brown lustrous flint	?	?	5	Small fragment with steep edge, probably broken from side scraper.
725-17	5—7	Red and purple "Alibates flint"	101	(34)	8	Side scraper made from long, curved spall; convex side has steep bit whole length along one edge, other edge broken.
725-20	5—5	Light-brown lustrous flint	90	34	8	Side scraper, similar to above.
725-21	Not illustrated	Light-brown lustrous flint	51	33	12	Side scraper, steep bit along one edge; high medial ridge; original nodule surface left on opposite edge.
725-22	5—2	Brown lustrous flint	67	42	11	Side scraper, one edge chipped, other retains nodule surface.
725-24*	4—9	Bluish flint	51	26	?	Side scraper fragment with medial ridge, one edge chipped; one end pointed, other broken (?).
733†	5—4	Lustrous yellow flint with pale-blue flecks	36	25	12	Snub-nosed end scraper, crudely chipped with high peak near center; heel end pointed.

*Not removed from bone matrix.
†Not from bison bed but in valley fill near by.

are plano-convex, that is, they are chipped on one face only, the upper or convex side, the under side being concave or curving into the percussion bulb, and completely unworked. The side scrapers are simply spalls which were given a steep bit all along one edge and around one or both ends. The opposite edge is either unworked, broken, or bears part of the original nodule surface. The two snub-nosed scrapers are somewhat better made, one in particular (725–15) being well formed with an evenly convex bit and its top flattened by removing the hump with one blow. The other end scraper (733) was less carefully made, has a high central peak, and the heel end is rather sharply pointed.

DISCUSSION

As the Plainview bison bone bed gives no evidence of being a campsite or workshop, but only the scene of a slaughter, the range of artifacts recovered is very narrow. The plano-convex scrapers and flake knife contribute nothing new to our knowledge of early American hunters, as similar artifacts have been found at most stations. The projectile points, however, provide a basis for defining a form which, though undoubtedly allied to Folsom and Yuma types, belongs with neither. To establish their meaning, we may briefly review the situation in regard to established types.

Following the classification of Yuma and Folsom artifacts by Renaud (1931; 1932; 1934) into numerous numbered "types" and "subtypes", some of which were said to be transitional and demonstrating relationships between Yuma and Folsom, Figgins (1935) stated that the two categories were distinct and could not be confused:

> ... In numerous Yuma artifacts there is slight concavity of the bases but this does not resemble that of Folsom types.... The squared and paralleling edges, or tapering from a maximum basal width, are no less necessary for the recognition of Yuma artifacts than are the deeply concave bases and broadened mid-sections for the identity of Folsom types. The better examples of Yuma artifacts are very rarely, and then scantily, widest across the mid-section. Folsom artifacts do not have squared bases, rarely paralleling edges, and never taper forward from a maximum basal width. The side chipping of most Yuma artifacts is remarkable for its delicacy and uniformity, frequently extending continuously across the blade.... I can discover nothing in support of the theory that Folsom artifacts are traceable to Yuma origin. There is no slightest evidence of intergradation of their characters....

Figgins admitted, however, that there were numerous variations in Yuma points, which he referred to as "less refined" and perhaps "imitative". The characters of squared bases and relatively narrow or unexpanded outlines were held to be constant through these variations.

Subsequent classifications, while admitting strong distinctions between the major Yuma and Folsom forms, stressed the difficulties surrounding those specimens which bore features attributable to both (Wormington, 1939; Roberts, 1940; Howard, 1943). Wormington's (1939) work provided an important step forward in the definition of five types: Classical Folsom (or True Folsom), Generalized Folsom, Collateral Yuma, Oblique Yuma, and Indeterminate Yuma. Folsom types were defined primarily on the basis of form and the unique feature of removing a central flute from one or both faces, while Yuma types were separated according to methods of chipping, as well as to form. Wormington then identified the points from several important sites, using her terminology. For example, five points found with a human burial near Browns Valley, Minnesota (Jenks, 1937), were classed as Oblique Yuma (2) and Indeterminate Yuma (3); those from the Lindenmeier, Colorado, site (Roberts, 1935; 1936) as mainly Classical Folsom but also including an Oblique Yuma and six Indeterminate Yuma; the Folsom type station in northeast New Mexico (Figgins, 1927; 1931) yielded only Classical Folsom; and the Clovis site, east-central New Mexico (Howard, 1935), Classical Folsom, Generalized Folsom, Collateral Yuma (2), and Indeterminate Yuma (1).

In discussing the types, Wormington (1939) concluded that:

> 1. The true Folsom differs radically from the collaterally flaked Yuma both as to shape and flaking technique. The Generalized Folsom differs from the Collateral Yuma as to shape and the occasional examples which show superficial similarities as to flaking technique are not sufficient to indicate any real relationship.

2. Both types of Folsom when compared with oblique-flaked Yumas show certain basic resemblances as to shape but in most cases the types of flaking are fundamentally different.

3. There are many points which can not as yet be classed with either type [category ?]. *They have been considered here with Yumas* since they accord with definitions of the modal type and it is the general consensus that the presence of a groove is a requisite for a point to be designated as a Folsom. The shapes represented include those usually concurrent with Collateral Yuma flaking and those characteristic of Oblique Yumas and Folsoms. *The majority are of the latter type.*... Accordingly, while some of these points appear to be Yuma variants, some could equally well be classed as ungrooved Folsoms. It is entirely probable that this series does not represent a homogeneous group.... (Italics by the present writer.)

Obviously, the weakest link in this typology is expressed under the third point. This was considered by a symposium held in Santa Fe, New Mexico, in September 1941 (Howard, 1943). The symposium clarified many matters by agreeing to abandon the following more ambiguous terms:

Folsomlike	Generalized Yuma
Folsomoid	Collateral Yuma
Unfluted Folsom	Indeterminate Yuma
Generalized Folsom	

On the other hand, agreement was reached on the recognition of the following distinct types:

Folsom Fluted (or simply, Folsom)
Clovis Fluted
Ohio Fluted (for forms in the eastern United States resembling Clovis Fluted but also revealing more variety; no type station or faunal association known)
Eden Yuma (previously Collateral Yuma)
Scottsbluff Yuma
Oblique Yuma (provisional name, for no type station or faunal association yet known)

This scheme appears to be very workable as far as it goes. It removed many specimens with conflicting characteristics from the field of known types. Thus, examples previously forced (with a great deal of artificial manipulating) into the seemingly inevitable Folsom-Yuma dichotomy were now admitted to be of unknown type and affiliation; "Indeterminate Yuma" and "Unfluted Folsom" points, in particular, were to await the discovery of type stations with specimens *in situ* before naming was to be attempted. Had this step not been taken, the projectile points from the Plainview bison bed would have aroused endless argument as to their "Folsom" or "Yuma" identification. As it is, they can be described as a new type without conflicting with any now recognized.

In some respects the Santa Fe terminology supports Figgins' earlier contention that there is no need to confuse Folsom and Yuma artifacts, for they have little in common (Figgins, 1935). Nonetheless, the Plainview points may be regarded as a possible transitional form between Folsom and Yuma types. The validity of such a view naturally must depend upon stratigraphic relations between all these forms, a matter which is the most serious barrier to their interpretation at present.

The differences between Folsom and Yuma cited above apparently still hold. That is, Folsom Fluted points are generally broader at midpoint than at the base, broad in relation to length; the basal concavity is deep and results in sharp tips at the basal corners. There is sometimes a small tip in the center of the basal concavity, they all have some degree of fluting on one or both faces, and they lack the regular collateral and oblique chipping of Yuma points. Yuma points (there is much argument as to whether they are projectile points or knives) are relatively

long and narrow, the length being three to five or more times the maximum width. The point of maximum width is usually at the base or shoulders although the edges may be parallel for at least half the distance forward; the basal end is typically squared, but the base line itself may be slightly concave, shallow notches often cut into the blade a short distance from the base to form a squared stem, and the chipping is often a remarkable example of supreme skill in that flakes of equal size were removed from both edges of the blade toward a medial ridge, or run obliquely across the faces. These features have been discussed and illustrated by Figgins (1935), Roberts (1935; 1936;1940), Wormington (1939; 1944), Howard (1935; 1943) and others.

Howard (1943) has added other significant items, among them that the place of greatest width of Folsom points occurs (1) above the midpoint, (2) below the midpoint, (3) the edges may be parallel from base to midpoint or further. He does not include the occasional occurrence of recurved edges, quite apparent in illustrations (*e.g.*, Howard, 1935, Pl. XXIV, Group I-4, Group II-1, 4; Pl. XXX, 1, 5; Pl. XXXVI, 1, 2) in which the basal and midpoint widths are approximately equal, but the edges form long, shallow inward curves between these points. Folsom points usually have rather short tips with strongly convex edges (especially when the maximum width is at midpoint or farther forward), but occasionally the tips are long and slim with nearly straight edges (*e.g.*, Figgins, 1935, Pl. II; Howard, 1935, Pl. XXXIII, top row, second from right; Howard, 1943, Pl. VIII, and p. 228–229). In this respect they sometimes resemble Yuma points.

Within the series of 18 whole and fragmentary Plainview points, certain similarities with Folsom types are apparent. In two instances the base is the widest part, but the blade is reduced only very slightly until contracted toward the tip. The edges are parallel from base to midpoint in at least four cases and probably so in three fragments (725–3, 725–7, 725–13). In seven cases, however, the maximum width occurs at or about the midpoint; in one of these the edges are gently recurved between base and midpoint (725–5). In no known case is the maximum width forward from midpoint. In these characters the series seems definitely more like Folsom than Yuma types. This apparently applies also to proportions of length and width. Plainview points are about three times as long as wide (range about 30 to 36 per cent with one, 725–1, equalling 42 per cent), whether maximum or basal width is taken. The range of width is quite restricted in known cases: 22 to 24 mm. at base and 22 to 26 mm. at midsection. Narrow or long Folsom points, and relatively short or broad Yuma artifacts, will both probably overlap Plainview points in proportions, but on the whole the latter are closer to Folsom. The basal concavity of Plainview points closely resembles that of Clovis Fluted and Ohio Fluted, both in depth and in recurving of the base line into the corners to form rounded "ears".

Regarding the distal end, three Plainview points have long, slender tips with nearly straight edges, ranging about 47 to 50 mm. in length, while nine have a much shorter tip, about 18 to 33 mm. long with decidedly convex edges. Folsom points also occasionally reveal the long and slender tips, although the short, rounded tip is more common.

Extended statistical studies will be needed for more precise knowledge of all these

types. The above matters suggest some rather close relationships between Plainview and the three recognized Folsom types. They probably would once have been termed "unfluted Folsom".

On the other hand, five specimens with a medial ridge and fairly well-defined collateral chipping suggest some affiliation with Yuma artifacts. In three cases this ridge is pronounced from midpoint to tip, but in the others it is low, and the flake scars only roughly oppose one another. In one case there is "ripple" or oblique chipping of a crude sort on the proximal end and collateral chipping on the distal end.

Plainview points share the grinding or smoothing of basal edges with both Folsom and Yuma types.

These matters suggest that the Plainview type represents a transition between Folsom and Yuma types, at least conceptually and perhaps historically. That Yuma points are later than Folsom has been suggested by Roberts at the Lindenmeier site, northeast Colorado (Roberts, 1940, p. 64):

> As a group the Lindenmeier Yumas constitute so small a percentage of the total number of points that they suggest intrusive or trade material rather than a trait in the complex.... The lowest level containing true Folsom points has thus far produced no Yuma specimens. The level above this has yielded examples of the *generalized style*, but *the others* occur much higher in the deposits. These latter are for the most part from the group with the oblique flaking. The *questionable forms* are fragments from points with horizontal flaking and a *rudimentary sort of dorsal ridge*. The facets are larger, more irregular, and exhibit poorer workmanship than is usually observed on Yuma points. For that reason their inclusion in the Yuma group has met with some disagreement.... If they actually are the adumbrative group, this would argue for an *earlier development of the oblique series*, with the *horizontally flaked, median-ridged the younger of the two true Yumas*. As far as the Lindenmeier site is concerned, it seems that there was only a late contemporaneity between the Yuma and the Folsom, with a later survival for the Yuma. (Italics by the present writer.)

The nature of the various points mentioned above will not be known clearly until Roberts' full report on Lindenmeier is available. Plainview points, or similar specimens, were probably present in this sequence. This would apply especially to the "generalized style" of the middle levels or to the "questionable forms" with rudimentary dorsal ridge found in upper levels. In his initial study Roberts (1935, p. 18) described two exceptional specimens which contrasted with the typical Folsom Fluted points from this site and which appear from his plates to resemble closely the Plainview type. One of those (Roberts, 1935, Pls. 5-*i*, 6-*i*) which he did not consider a Folsom point was found "on top of the old soil layer—not down in it as were most of the true forms." Another (Pls. 7-*h*, 8-*h*) was "an aberrant form" and occurred in association with typical Folsom material in the deep deposit. There thus appears the possibility that Plainview points were found as a minor element in all Lindenmeier levels. More detailed study might establish their chronologic relationship to Folsom and Yuma types more definitely. Data will be necessary from other localities. At present it is not clear whether points in the middle and upper levels at Lindenmeier were also found in association with extinct bison.

Figgins (1935, p. 7) has also expressed the view that Yuma types were of later development than Folsom. Renaud (1932; 1934) and Jenks (1937) have claimed that Yuma were the earlier, with progressive changes leading to Folsom types. As the latter view was based on an ideal technical progression and not on stratigraphy it is not accepted by most authorities.

Several other instances will bear consideration as belonging to the Plainview type. (Table 6). As the comparisons are made entirely from published illustrations, it is not certain that the specimens actually belong to this type. In some cases, their dimensions do not fall strictly within the ranges given above for the type-site series from Plainview. This may mean that we do not yet understand the full range of variations within the type. However, the Plainview type only partly cuts into the residue of unclassified styles left by the Santa Fe symposium, and probably further types will be recognized which overlap Plainview as it overlaps some of those now known. We may reasonably expect somewhat more variation in Plainview points than observed in the type-site series. Thus, the length, width, and depth of basal concavity may occasionally range slightly higher or lower than in the type-site series.

To Table 6 might be added the two specimens found with remains of extinct bison on Lone Wolf Creek near Colorado City, Texas (Figgins, 1927, Fig. 1). These have been termed "Yuma" points, but Figgins (1935) has denied affiliation with either Yuma or Folsom types and states that the points in question "might best be regarded as a subject for wholly independent studies". The basal fragment has a concave base and appears quite similar to Plainview points. The complete specimen, however, while it resembles the former in size and shape, has a slightly convex base and therefore does not agree with our conception of Plainview. There is, of course, no reason why two somewhat different styles could not appear here together. Regarding the Browns Valley, Minnesota, artifacts (Jenks, 1937), Roberts has considered the term "Yuma-Folsom" inappropriate and suggested they be called "Browns Valley points" (Roberts, 1940, p. 65). Six points which Jenks states "typologically appear to belong to the Yuma-Folsom type" were found with the burial, and two or three of these resemble Plainview points. The surface specimen from Pelican Rapids (Jenks, 1937, Pl. 8, fig. A) strongly suggests a Plainview point.

The occurrences listed in Table 6 suggest that Plainview points were widely distributed from Alaska to central Texas. That they are distinct from Folsom and Yuma types is shown, in addition to the foregoing arguments, by their failure to mix to any great extent with these types. In several instances where comparable numbers of specimens have been found in association with extinct bison, and fluted points are the rule, unfluted specimens are rare or absent, and *vice versa*. Thus, the Folsom site in northeast New Mexico has so far yielded some 19 whole and fragmentary projectile points (Wormington, 1939), all of which are Folsom Fluted. The Lipscomb bison quarry in Lipscomb County, northern Texas Panhandle (Schultz, 1943), produced 18 projectile points and fragments thereof, all of which appear from the illustrations to be Folsom Fluted. In maximum width the Lipscomb specimens agree closely with Plainview points, but the base width and total length range considerably less. Again, the Linger site in San Luis Valley, south-central Colorado (Hurst, 1943), yielded 14 examples of Folsom Fluted and one described as "Formerly 'generalized Yuma' ", which can now be said to conform to the Plainview type. At the Lindenmeier site, northeast Colorado (Roberts, 1935; 1936), the situation is complex; Folsom points evidently preceded Yumas, and Plainview points possibly occur in the sequence. On the other hand, the Scottsbluff, Nebraska, bison quarry (Schultz and Eiseley, 1935; Barbour and Schultz, 1936) has produced several

TABLE 6.—*Some projectile points suggestive of the Plainview type*

Reference	Locality	Illustration no.	Manner of occurrence
Renaud, 1931	Not given	Figs. 2, 5, 12, 22, 23, 24	Not given
Renaud, 1932	Not given	Pl. II, "Type 2b, base B2" and "Type 3a, base B1"	Not given
Meserve and Barbour, 1932	Meserve bison quarry near Grand Island, Nebraska	Fig. 151 (first specimen found)	With *Bison occidentalis*
Barbour and Schultz, 1932a	Same	Fig. 165	Same
Schultz, 1932	Same	Fig. 166-*b*,-*c*	Same
Schultz and Eiseley, 1935	Scottsbluff bison quarry, Nebraska	Pl. 8-*a*	With various extinct bison, including *B. occidentalis*, and Scottsbluff Yuma points
Barbour and Schultz, 1936	Same	Fig. 202-*a*	Same
Barbour and Schultz, 1936	Sioux County artifact sites, Nebraska	Fig. 202-*d*	Buried hearth site ?
Howard, 1935	Clovis, New Mexico	Pl. XXXVII-3	With extinct fauna
Howard, 1935	New Mexico and Colorado	Pls. XXX-2, XXXVIII-1	Not given
Figgins, 1934	Colorado and Wyoming	Pl. I-9, -10, -11, -12(?)	Not given
Strong, 1935	Signal Butte, Nebraska	Pl. 25, fig. 1-*o* (10 specimens)	Level I, no extinct fauna (note also many stemmed points)
Roberts, 1935	Lindenmeier site, Colorado	Pls. 5-*i*, 6-*i*	Above level containing extinct bison and Folsom points
Roberts, 1935	Same	Pls. 7-*h*, 8-*h*	Folsom level with extinct bison
Roberts, 1936	Same	Pl. 4, 2d in 2d row	Same
Jenks, 1937	Browns Valley, Minnesota	Pl. 6-A, -B	With human burial, age estimated 8,000 to 12,000 years
Jenks, 1937	Pelican Rapids, Minnesota	Pl. 8-A	Surface find
Rainey, 1940	Tanana Valley, Alaska	Fig. 16, No. 1	Pleistocene "muck"
Hibben, 1943	Near Circle, Alaska	Pl. XV-*d*	"Mucks"
Hibben, 1941	Sandia Cave, New Mexico	Pl. 5, No. 2; Pl. 6-*h*	In Folsom level, including extinct fauna, Folsom Fluted points, side and end scrapers, gravers, *etc.*
Ray, 1942	McLean site, Abilene region, Texas	Pl. 33, Nos. 2, 4	"On the McLean site alluvium"
Roberts, 1942	San Jon, New Mexico	Fig. 2-*a* (has squared base and only generally resembles the Plainview points)	With extinct bison
Hurst, 1943	Linger site in San Luis Valley, Colorado	Pl. XIII, No. 1	With *Bison taylori* and Folsom Fluted points

extinct bison, Scottsbluff Yuma points, one possible Plainview point, and no fluted. Therefore, Plainview points probably occupied a historical position differing somewhat from Folsom and Yuma although all are found associated with extinct forms of bison.

The plano-convex side and end scrapers from the Plainview bone bed afford no further conclusions. Similar artifacts are found in association with Folsom material and indeed continue in Plains cultures up to historic times. On an early level, one may note the plano-convex scrapers found at Lindenmeier (Roberts, 1935, Pls. 9–12; 1936, Pls. 5–6, 8, 10–11); in the Folsom level in Sandia Cave, New Mexico (Hibben, 1941, Pls. 8–9); Lipscomb bison quarry, Texas (Schultz, 1943, Pl. XII, four to right on bottom row); and probably other sites.

CONCLUSIONS

The 18 whole and fragmentary projectile points found in association with remains of large bison at Plainview, Texas, are assumed to belong to a single type. This type exhibits some characteristics of Folsom Fluted and Clovis Fluted but is itself unfluted; the chipping on some specimens is similar to collateral work found on Yuma types. With the establishment of a third category, Plainview, in addition to Folsom and Yuma, it is thought that many conflicts and ambiguities in projectile-point terminology will be alleviated. Conceptually, and perhaps historically, Plainview points appear to occupy an intermediate position between Folsom and Yuma types. All may be found with forms of bison now extinct, but their precise relationships are not yet known.

REFERENCES CITED

Antevs, Ernst (1935) *The occurrence of flints and extinct animals in pluvial deposits near Clovis, New Mexico, Pt. 2, Age of the Clovis Lake clays*, Acad. Nat. Sci. Philadelphia, Pr., vol. 87, p. 304–312.

Anthony, H. E. (1937) *Animals of America*, Garden City Pub. Co., New York, N. Y.

Barbour, E. H., and Schultz, C. B. (1932a) *The mounted skeleton of Bison occidentalis and associated dart-points*, Nebr. State Mus., Bull., vol. 1, no. 32, p. 263–270.

———— — ———— (1932b) *The Scottsbluff bison quarry and its artifacts*, Nebr. State Mus., Bull., vol. 1, no. 34, p. 283–286.

———— — ———— (1936) *Paleontologic and geologic consideration of early man in Nebraska with notice of a new bone bed in the early Pleistocene of Morrill County, Nebraska*, Nebr. State Mus., Bull., vol. 1, no. 45, p. 431–450.

Brown, Barnum (1929) *Folsom culture and its age* (Abstract), Geol. Soc. Am., Bull., vol. 40, p. 128–129.

Bryan, Frank (1938) *A review of the geology of the Clovis finds reported by Howard and Cotter*, Am. Antiquity, vol. 4, p. 113–130.

Bryan, Kirk (1929) *in* Brown, Barnum (1929) p. 128–129.

———— (1941) *Correlation of the deposits of Sandia Cave, New Mexico, with the glacial chronology*, Smithson. Misc. Coll., vol. 99, no. 23, p. 45–64.

————, and Ray, Louis L. (1940) *Geologic antiquity of the Lindenmeier site in Colorado*, Smithson. Misc. Coll., vol. 99, no. 2, 76 pages.

Chaney, Ralph W., and Mason, Herbert L. (1936) *A Pleistocene flora from Fairbanks, Alaska*, Am. Mus. Nat. Hist., Novi., no. 887, 17 pages.

Cook, H. J. (1927) *New geological and paleontological evidence bearing on the antiquity of mankind in America*, Nat. Hist., vol. 7, no. 3, p. 240–247.

Cotter, John Lambert (1937) *The occurrence of flints and extinct animals in pluvial deposits near Clovis, New Mexico, Pt. 4, Report on excavation at the gravel pit, 1936*, Acad. Nat. Sci. Philadelphia, Pr., vol. 89, p. 1–16.

——— (1938) *The occurrence of flints and extinct animals in pluvial deposits near Clovis, New Mexico, Pt. 6*, Acad. Nat. Sci. Philadelphia, Pr., vol. 90, p. 113–117.

Darwin, Charles (1890) *Journal of researches: a naturalist's voyage around the world*, 2d ed., D. Appleton and Co., New York.

Evans, Glen L., and Meade, Grayson E. (1945) *Quaternary of the Texas High Plains*, Univ. Texas, Pub. 4401, p. 485–507.

Figgins, J. D. (1927) *The antiquity of man in America*, Nat. Hist., vol. 27, no. 3, p. 229–239.

——— (1931) *An additional discovery of the association of a "Folsom" artifact and fossil mammal remains*, Colo. Mus. Nat. Hist., Pr., vol. 10, no. 4, p. 23–24.

——— (1934) *Folsom and Yuma artifacts*, Colo. Mus. Nat. Hist., Pr., vol. 13, no. 2, p. 1–6.

——— (1935) *Folsom and Yuma artifacts*, Colo. Mus. Nat. Hist., Pr., vol. 14, no. 2, p. 1–7.

Hay, O. P., and Cook, H. J. (1928) *Preliminary descriptions of fossil mammals recently discovered in Oklahoma, Texas, and New Mexico*, Colo. Mus. Nat. Hist., Pr. vol. 8, no. 2, pt. 1, p. 33.

——— — ——— (1930) *Fossil vertebrates collected near, or in association with, human artifacts at localities near Colorado, Texas, Frederick, Oklahoma, and Folsom, New Mexico*, Colo. Mus. Nat. Hist., Pr., vol. 9, no. 2, p. 4–40.

Hibben, Frank C. (1941) *Evidences of early occupation in Sandia Cave, New Mexico, and other sites in the Sandia-Manzano region*, Smithson. Misc. Coll., vol. 99, no. 23, 44 pages.

——— (1943) *Evidences of early man in Alaska*, Am. Antiquity, vol. 8, p. 254–259.

Howard, Edgar B. (1935) *Evidence of early man in North America, based on geological and archaeological work in New Mexico*, Univ. Pa. Mus., Jour., vol. 24, nos. 2–3, p. 55–171.

——— (1943) *The Finley site: discovery of Yuma points, in situ, near Eden, Wyoming*, Am. Antiquity, vol. 8, p. 224–234.

Hurst, C. T. (1943) *A Folsom site in a mountain valley of Colorado*, Am. Antiquity, vol. 8, p. 250–253.

Jenks, A. E. (1937) *Minnesota's Browns Valley man and associated burial artifacts*, Am. Anthropol. Assoc., Mem. 49, 49 pages.

Lucas, F. A. (1899) *The fossil bison of North America*, U. S. Nat. Mus. Pr., vol. 21, p. 755–771.

Meserve, F. G., and Barbour, E. H. (1932) *Association of an arrow point with* Bison occidentalis *in Nebraska*, Nebr. State Mus., Bull., vol. 1, p. 239–242.

Price, W. Armstrong (1944) *The Clovis site: regional physiography and geology*, Am. Antiquity, vol. 9, no. 4, p. 401–407.

Rainey, Froelich G. (1939) *Archaeology in central Alaska*, Am. Mus. Nat. Hist., Anthropol. Papers, vol. 36, pt. 4, p. 351–405.

——— (1940) *Archaeological investigation in central Alaska*, Am. Antiquity, vol. 5, p. 299–308.

Ray, C. N. (1942) *Ancient artifacts and mammoth's teeth of the McLean site*, Texas Arch. Paleont. Soc., Bull., vol. 14, p. 137–138.

Renaud, E. B. (1931) *Prehistoric flaked points from Colorado and neighboring districts*, Colo. Mus. Nat. Hist., Pr., vol. 10, no. 2, p. 6–21.

——— (1932) *Yuma and Folsom artifacts (new material)*, Colo. Mus. Nat. Hist., Pr., vol. 11, no. 2, p. 5–18.

——— (1934) *The first thousand Yuma-Folsom artifacts*, Univ. Denver, Dept. Anthropol.

Roberts, Frank H. H., Jr. (1935) *A Folsom complex. Preliminary report on investigations at the Lindenmeier site in northern Colorado*, Smithson. Misc. Coll., vol. 94, no. 4, Pub. 3333, 35 pages.

——— (1936) *Additional information on the Folsom complex; report on the second season's investigations at the Lindenmeier site in northern Colorado*, Smithson. Misc. Coll., vol. 95, no. 10, Pub. 3390, 38 pages.

——— (1940) *Developments in the problem of the North American Paleo-Indian*, Smithson. Misc. Coll., vol. 100, p. 51–116.

——— (1942) *Archaeological and geological investigations in the San Jon district, eastern New Mexico*, Smithson. Misc. Coll., vol. 103, no. 4, 30 pages.

Schultz, C. Bertrand (1932) *Association of artifacts and extinct mammals in Nebraska*, Nebr. State Mus., Bull., vol. 1, no. 33, p. 271–282.

——— (1943) *Some artifact sites of early man in the Great Plains and adjacent areas*, Am. Antiquity, vol. 8, p. 242–249.

———, and Eiseley, Loren C. (1935) *Paleontological evidence for the antiquity of the Scottsbluff bison quarry and its associated artifacts*, Am. Anthropol., n. s., vol. 37, p. 306–319.

——— — Stout, Thompson M. (1945) *Pleistocene loess deposits of Nebraska*, Am. Jour. Sci., vol. 243, p. 231–244.

Sellards, E. H. (1916) *Human remains and associated fossils from the Pleistocene of Florida*, Fla. State Geol. Survey, 8th Ann. Rept., p. 123–160.

——— (1938) *Artifacts associated with fossil elephant*, Geol. Soc. Am., Bull., vol. 49, p. 999–1009.

——— (1940) *Early man in America, index to localities and selected bibliography*, Geol. Soc. Am., Bull., vol. 51, p. 373–431.

——— (1945) *Fossil bison and associated artifacts from Texas* (Abstract), Geol. Soc. Am., Bull., vol. 56, p. 1196–1197.

Stock, Chester, and Bode, Francis D. (1936) *The occurrence of flints and extinct animals in pluvial deposits near Clovis, New Mexico, Pt. 3, Geology and vertebrate paleontology of the late Quaternary near Clovis, New Mexico*, Acad. Nat. Sci. Philadelphia, Pr., vol. 88, p. 219–241.

Strong, William Duncan (1935) *An introduction to Nebraska archaeology*, Smithson. Misc. Coll., vol. 93, no. 10, 315 pages.

Winship, George Parker (1896) *The Coronado expedition, 1540–1542*, Bur. Ethnol., 14th Ann. Rept., p. 329–613.

Wormington, H. M. (1939) *Ancient man in North America*, Colo. Mus. Nat. Hist., Popular Ser., no. 4, 80 pages.

——— (1944) *Ancient man in North America*, Colo. Mus. Nat. Hist., Popular Ser., no. 4, 2d edition, 89 pages.

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MANUSCRIPT RECEIVED BY THE SECRETARY OF THE SOCIETY, MAY 3, 1946

FIGURE 1. LOOKING NORTHWESTWARD INTO THE BISON QUARRY
Photo indicates depth of overburden removed from bone bed. The stakes indicate the location of artifacts in place among the bison bones.

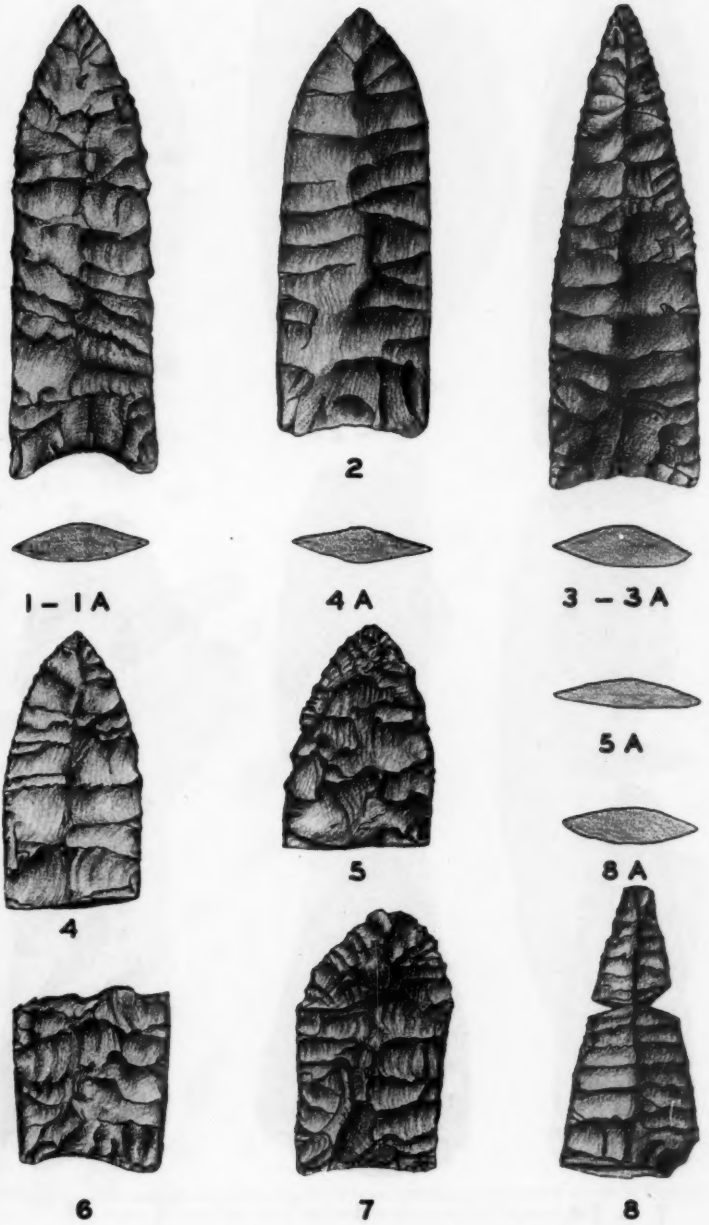
FIGURE 2. LOOKING EASTWARD ACROSS THE BONE BED
Fossil bison bones and artifacts being removed.

THE BISON QUARRY

FIGURE 1. SKULL OF THE PLAINVIEW BISON
Approximately ⅛ natural size; Spread of horns, 875 mm.; overall length of skull, 625 mm. (Texas Memorial Museum no. 725–26.)

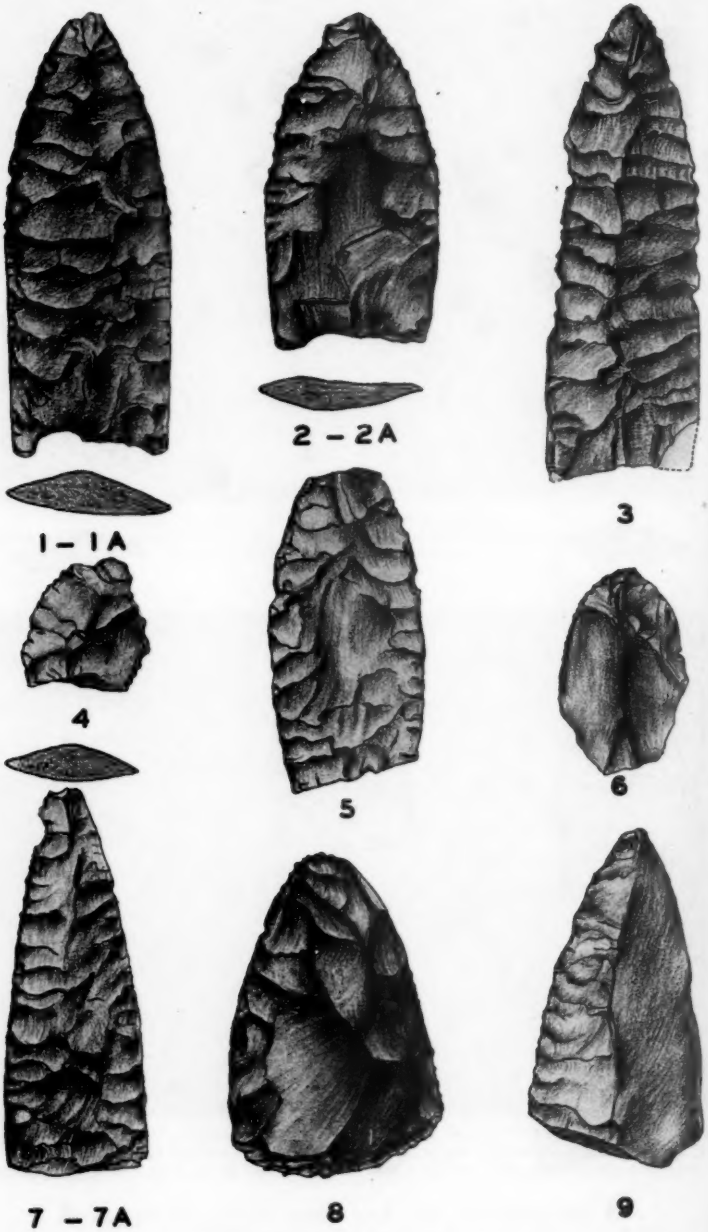
FIGURE 2. A PART OF THE BONE BED
Large bone at left of center is *Bison taylori* metacarpal bone, length 238 mm. At right of center is projectile point no. 725–23 (location indicated by arrow) in contact with sacral vertebra of bison.

SKULL OF PLAINVIEW BISON AND PART OF BONE BED WITH ARTIFACT IN PLACE



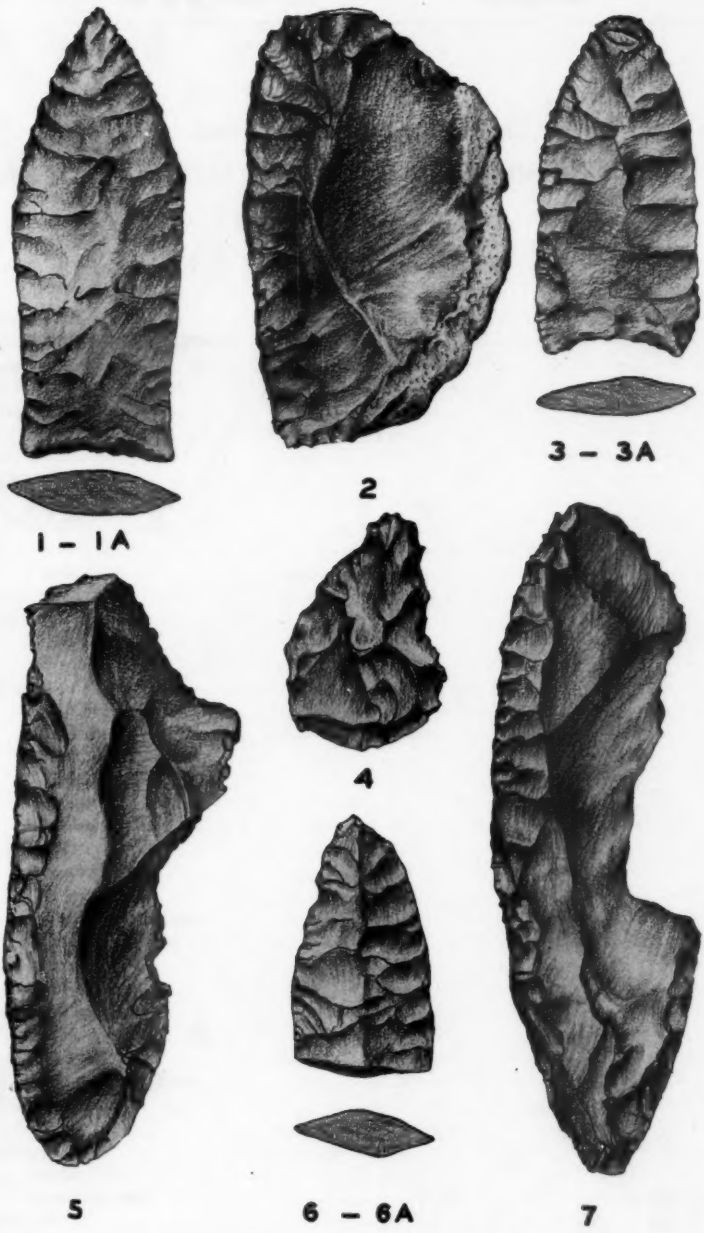
Projectile points from the bison bone bed. Cross sections of the points shown by 1A, *etc.* The projectile point shown in Figure 2 has not been removed from its place in the bone bed (*see* Pl. 2, Figure 2). Natural size.

ARTIFACTS FOUND IN THE BONE BED — PROJECTILE POINTS



Projectile points and scrapers from the bison bone bed. The scraper shown in Figure 9 has not been removed from its place in the bone bed. Natural size.

ARTIFACTS FOUND IN THE BONE BED — PROJECTILE POINTS AND SCRAPERS



Projectile points and scrapers from the bison bone bed except the scraper shown in Figure 4, which is from the valley stream deposits near by. Natural size.

ARTIFACTS FOUND IN THE BONE BED AND STREAM DEPOSITS

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EARLY MAN IN AMERICA

INDEX TO LOCALITIES AND SELECTED BIBLIOGRAPHY, 1940–1945

BY E. H. SELLARDS

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ABSTRACT

This paper, containing notice of the principal investigations of early man in America for the years 1940 to 1945 inclusive, is a continuation of a similar compilation for the years 1839 to 1939, published in 1940. Special attention is directed to the conditions of occurrence and to the associated fossils. The term early man is used to apply to human materials that, from the stratigraphic conditions, associated fossils and artifacts, or for other reasons, are believed to be of some appreciable antiquity in a geologic sense. Contributions of recent years include a considerable

number of papers relating to the time interval between the disappearance or reduction of the great mammalian fauna of the Pleistocene and pottery-bearing horizons. The climatic fluctuations within this time interval have likewise received attention. The stratigraphic units of the early Recent are being differentiated and named and the contained human materials studied. Through the years some progress has been made in determining the implements used by early man in hunting for and processing particular animals; those used in hunting the bison and elephant are among the best known.

INTRODUCTION AND ACKNOWLEDGMENTS

The writer (1940a) published an index to localities and a selected bibliography of literature on early man in America, especially North America, including record of discoveries through one century, 1839 to 1939. To the original list of localities and bibliography additions have been made as follows: Several references which had been overlooked were later added (Sellards, 1940b); Eiseley (1941) called attention to the omission from the bibliography of an extended publication by Wallace (1887); Fischel (1941) added a number of localities; Montagu (1942) and Montagu and Peterson (1944) assembled additional information on Koch, indicating that certain of the collections made by Koch in Missouri reached the Philadelphia Academy of Science, the British Museum, and the Royal Museum of the University of Berlin. From 1940 to 1945 inclusive investigations in this field have been moderately active; several new localities were discovered, and numerous papers published.

The writer is indebted to all who have published on the subject and especially to a great many workers in this field who, through correspondence or otherwise, have aided in checking locality and bibliography references. In connection with assembling the bibliography, special acknowledgment should be made to a bibliography published by Excavators' Club (Brew, 1943), to bibliographies contained in *American Antiquity;* and to various bibliographies accompanying many of the papers on early man. The unavoidable defects of a publication of this kind are recognized, and, realizing that both the bibliography and index are incomplete, the author will greatly appreciate notation of additions or corrections.

INDEX TO LOCALITIES

The term "Early Man" is impossible to define exactly but is understood to include man of some appreciable antiquity in a geologic sense. The earlier paper (Sellards, 1940a) includes localities in which human materials had been found or were reported to have been found in association with extinct species of animals or plants, or in deposits that appear to be of an age equivalent to those that elsewhere contain extinct species. It is becoming increasingly difficult to separate the localities and the literature into "Early" and "Recent". In the present paper it has seemed desirable to include localities discovered 1940 to 1945 that, from the known stratigraphic conditions, or for other reasons, are believed to be of some appreciable antiquity, although not necessarily of such age as to contain extinct animals. This has seemed desirable because of the considerable amount of work being done and number of papers now being issued dealing with deposits that lie within the interval between deposits that contain extinct animals and those that are recognized as relatively

recent. In this way the present paper, although not containing all known non-pottery localities, has been enlarged to include a considerable number of sites that are of prepottery age, but which may be too recent to contain remains of extinct animals. A considerable number of publications have appeared in recent years relating to late Pleistocene and early Recent stratigraphy. Some of these having an important bearing on the early man problem are included in the bibliography.

Localities cited in the 1940 publication are not again listed, except to indicate additional publications. Comments are made on a few of these previously listed localities. General papers containing brief reference to many localities will be found in the bibliography but are not cited for each locality mentioned. The localities are listed alphabetically by states; the publications, alphabetically by authors.

NICARAGUA

MANAGUA

Managua.—Locality a quarry for building stone at El Cauce, a short distance west of Managua. Publications: Richardson (1941); Richardson and Ruppert (1942).

The building stone being quarried at this locality is rock formed from a succession of volcanic mud flows. On the top surface of the oldest of these mud flows are tracks of barefooted humans and of peccary, otter, lizard, a large bird, and perhaps other animals. A stream channel, which had cut into the hardened mud flows to a depth of 3 m. and width of 20 m., was subsequently filled with sand and boulders. After completion of the stream fill, a fall of pumice occurred, followed by deposition of humus, more pumice, and finally the present top soil. According to Richardson and Ruppert, the tracks of 17 humans were found. Occurrence of human tracks at this locality were reported by Earl Flint many years ago (Brinton, 1887; Lothrop, 1926). More accurate data to determine the age of the mud flows have not yet been secured.

CANADA

SASKATCHEWAN

D'Arcy.—Locality a gravel pit in the side of a ravine, 9 miles southeast of D'Arcy. Publication: Vigfusson (1940).

From this locality has been obtained a carved piece of pink sandstone, approximately the size of a man's head. A cup-shaped depression has been made in what may be called the top of the stone, and human faces have been carved on the sides. Three faces were completed, with partial representation of a fourth. No associated human materials or fossils were found, and the age of the object is unknown.

MEXICO

DISTRITO FEDERAL

Tequixquiac.—Locality a deep trench at Tequixquiac, near Mexico City. Publication: DeTerra (1946).

At this locality Doctor DeTerra found bone tools and stone artifacts in bone beds believed to date from the last glacial advance (personal communication, April 21, 1946).

UNITED STATES

ALASKA

Chinita Bay.—Locality at the west and southwest sides of Chinita Bay at the north side of Cook Inlet. Publication: Hibben (1943).

The artifacts occur in a humus-stained stratum which overlies blue clay and is itself overlain by muck and peat deposits. The projectile points found are Yuma-like.

Fairbanks.—Various localities in the Tanana River region where gold mining from gravel deposits underlying frozen silt, or so-called "muck," has been in progress. Announced by Collins (1937). Principal publications: Chaney and Mason (1936); Hibben (1943; 1944); Rainey (1939; 1940).

The localities yield a great abundance of animal and some plant remains. Many of the mammals are of extinct species, while most of the plants are of recent species. Some mixing of materials seems to have occurred, due possibly to movement of the silt during periods of partial thawing.

These discoveries in Alaska are of paramount importance as indicating the spread of these early cultures and quite certainly will lead to additional developments in that region. The men by whom these artifacts were made may have been recent arrivals from Asia. However, one should also entertain the possibility that the earliest cultures thus far found in Alaska may have originated in the Great Plains region of North America or elsewhere in the Western Hemisphere and subsequently spread northward. Only full development of the facts will determine whether or not these cultures were brought to America from Asia or originated in the Western Hemisphere.

ARIZONA

Cave Creek.—Locality near Portal on the east slope of Chiricahua Mountains in southeastern Arizona. Principal publication: Sayles and Antevs (1941).

This locality is a midden which had become covered with peat. The artifacts consist of handstones, milling stones, and tools made by percussion flaking. Sayles regards this culture as distinct from, and later than, the Sulphur Springs stage culture and has named it the Chiricahua stage of the Cochise culture. This culture has been found also in several sites on Whitewater Draw and elsewhere in southeastern Arizona. No pottery and no projectile points have been found in this culture. The animal remains found in the midden are of recent species only.

Fairbanks.—Locality on San Pedro River near Fairbanks. Principal publication: Sayles and Antevs (1941).

The artifacts from this locality consist of grinding tools and an abundance of chipped implements, some of which were made by pressure flaking. Projectile points are numerous. The few animal remains found with the artifacts represent living species. No pottery is present. Regarded by Sayles and Antevs as later than the Chiricahua culture.

Little Colorado River.—Locality in the valley of Little Colorado River between Hoolbrook and Cameron. Publication: Bartlett (1943).

Artifacts found on the surface. No extinct species known to be associated with the artifacts. No stratigraphic information available.

Papago Springs Cave.—Cave located near Sonoita. Publications: Colbert and Chaffee (1939); Eiseley (1944); Skinner (1942).

Pottery in Papago Springs Cave has been referred to by Colbert and Chaffee (1939) as having been found in association with extinct mammals. Correction is made by Skinner (1942), who finds that the pottery was not in association with the fossils but occurs at a higher level.

Ventana.—Locality a large rock shelter in the Papago Indian Reservation. Publication: Haury (1943).

The surface layers of the cave contain modern Indian relics and, below this, pottery and prepottery horizons. The artifacts of the uppermost of the prepottery horizons are said to resemble the San Pedro and Chiricahua stages of the Cochise culture of southeast Arizona, together with a great abundance of projectile points resembling those of the Mohave and Pinto basins of California. The fauna at this level consists of modern species. The oldest artifact-bearing stratum of the cave contains a culture not unlike the Folsom complex, associated with bison, ground sloth, horse, and tapir. According to Haury, a disconformity separates the basal stratum from the overlying deposits.

Whitewater Draw.—Publication: Sayles and Antevs (1941).

Six sites containing culture of the Sulphur Springs stage have been found on Whitewater Draw. Of these, Double Adobe site, 12 miles northwest of Douglas, is considered the type site of this stage of the Cochise culture. The human materials found include fragmentary parts of a dolichocephalic skull and artifacts, including handstones, milling stones, percussion-flaked tools such as knives, scrapers, axes, and hammerstones. No projectile points were found in the Sulphur Springs stage of the Cochise culture. The mammalian remains additional to man of this stage, identified by Stock and Howard, include horse, dire wolf, mammoth, bison, coyote, rabbit, and prong-horned antelope, the first three named being of extinct species. Only a few land and fresh-water mollusks were found in the horizons containing artifacts and fossils of the Sulphur Springs stage, all of which are of species living in this region at the present time. Antevs regards the Sulphur Springs stage as of the age of the "last pluvial". Fossils were reported from some of these localities by Cummings (1927; 1928).

The Sulphur Springs stage is overlain in Whitewater Draw at one or more sites by the Chiricahua and San Pedro stages, in neither of which have remains of extinct species of mammals been found (Sayles and Antevs, 1941).

CALIFORNIA

Borax Lake.—Publications: Antevs (1939a); Harrington (1939a; 1939b; 1942; 1945; 1946).

On the basis of excavations made in 1938, Harrington reported a Folsom culture underlain by artifacts which he considered by reason of their position in the deposits as pre-Folsom. The more extensive excavations in 1942 and 1945 revealed that the Folsom culture at this locality does not overlie the reported pre-Folsom culture but that the deposits contain a mixture of cultures, the most abundant cultural type

being related to the Mohave Lake culture but with Folsom or Folsom-influenced cultures present. Harrington does not mention the possibility of a mixing of various cultures by redeposition, but the possibility of mixture by redeposition should be closely examined at this locality.

Los Angeles.—Publication: Lopatin (1939).

Lower Klamath Lake.—Locality in Lower Klamath Lake near the Oregon-California boundary line. Principal publications: Antevs (1940); Cressman (1940a); Cressman *et al.* (1942).

The actual association of artifacts and fossils at the localities designated as the "Narrows" and the "Cove" seems not to have been established on direct observation, but they are said to have been derived from the same thin stratum. The mammalian fossils include camel, horse, and a proboscidian.

Rancho La Brea.—In the previous listing of this locality the writer (1940a) overlooked a paper by Woodward (1937) in which an atlatl and some other artifacts are reported from pit 66–67.

COLORADO

Lindenmeier.—Publications: Bryan (1941a); Bryan and Ray (1940); Cassell (1941); Roberts (1939; 1940b; 1945a).

Bryan and Ray (1940) have made a detailed study of geologic conditions at the Lindenmeier site in Colorado. They identify the deposits containing the Folsom culture at Lindenmeier as of the Coral Creek glacial substage of that region, designated by them as Wisconsin III. Wisconsin III in turn is placed in time as of the order of 25,000 years ago.

San Luis Valley.—The locality is a "blow out" in sand dunes. Publications: Hurst (1937; 1941; 1943).

Fossil bison bones and artifacts were found on the surface. The bone bed extends to a maximum depth of 2 feet but mostly to only a foot or less. The artifacts are mostly of the Folsom complex. The bison, identified from metacarpel bones, is regarded by Granger and by Simpson as possibly *Bison taylori.*

FLORIDA

Bon Terra Farm.—Locality about 29 miles south of St. Augustine. Publication: Howard (1940).

Many fossils, including extinct mammals, are found at this locality in muck or peat deposits. One artifact has been reported in association with a mastodon jaw. Howard did not have the opportunity of verifying this occurrence and did not find additional artifacts.

Melbourne and Vero.—Publications: McCown (1941); Cooke (1945); Stewart (1946).

Important new light has been thrown on these two Florida localities by a recent publication by Dr. T. D. Stewart, Curator of Physical Anthropology, U. S. National Museum. In 1917 the present writer submitted to Dr. Aleš Hrdlička a human skull and some bones obtained at the Vero locality. The human skull which Gidley obtained at the Melbourne locality also came to Hrdlička for reconstruction and

study. Among Doctor Hrdlička's statements (1918, p. 55–56) on the Vero skull are the following:

"The skull is large, finely shaped, of thoroughly modern features, and unusually thin. . . . The skull and bones are Indian, but they seem to belong to a type such as can occasionally be found among the Eastern Algonquian, or among the Sioux, rather than in Florida."

Of the Melbourne skull Hrdlička said (1937, p. 98):

"It is the skull of an Indian male, of advanced adult age, undeformed, brachycranic, high, and in general presenting the ordinary Florida mound Indian type and characters."

Doctor Stewart, after reconstructing and restudying these two skulls, has come to conclusions widely at variance with those arrived at by Doctor Hrdlička. The following statements from his paper represent a part only of his discussion of these two skulls (Stewart, 1946, p. 11, 19, 22):

"Although Hrdlička's illustration [Vero skull] shows a dolichocranic form, he fails to give measurements or to mention this fact. . . . In the foregoing sections I have attempted to show that: 1, the first reconstruction [by Hrdlička] of the Melbourne skull is unbelievably bad from every point of view; 2, that the second reconstruction is anatomically convincing; and 3, that as now reconstructed the Melbourne skull is surprisingly similar in form to the Vero skull, which was found under like circumstances. I have shown, moreover, that the fragmentary nature of the Melbourne skull makes it impossible to determine its original form with complete accuracy. Nevertheless, the new version must approximate the original form because it depends upon careful matching of the fragments and not upon a preconceived notion of what the form was. . . .

"It should be clear from the foregoing discussion that the Melbourne and Vero skulls, instead of being like the majority of recent Florida Indians, are rather like their more long-headed neighbors to the north and therefore consistent with what little we know of the earlier American types. That these earlier types were very little, if any, different from recent American Indians seems quite likely in view of Weidenreich's (1939) description of Upper Paleolithic skulls from China. So modern-seeming are these skulls that in one case Weidenreich has found his best comparison with a long-headed Texas Indian. Here, in spite of being separated by at least 20,000 years and the Pacific Ocean, these two skulls are of the same type. This new viewpoint on the physical characteristics of the first peoples to reach this continent from Asia is set forth in the following statement by E. A. Hooton (1937, p. 112):

'To me it seems clear that the Late Pleistocene antiquity of a human skeleton found in the New World cannot be refuted by a demonstration of the modernity of its anatomical characters alone. *Homo sapiens* was full-fledged in the Old World before the end of the glacial period. Late glacial entrants into the Americas need not prove their age by an array of archaic and simian physical features. The acid test of their antiquity must be geological. . . . On the whole, it seems to me that American anthropologists without relaxing their determination to submit each find of allegedly fossil man to every possible test of archaeological, geological, and paleontological antiquity, should not impose unreasonable morphological restriction upon candidates for recognition.'

"Thus, if we are correct in our conception of man's physical development at the close of the Ice Age—that he was relatively long-headed and of modern form—there is no reason from the viewpoint of morphology for denying such antiquity to the Melbourne and Vero remains."

The skulls, as interpreted by Doctor Stewart, do not of themselves prove the age of the deposits in which they are found. Of great importance is the fact that with this interpretation they also, contrary to Hrdlička's conclusions, do not stand in the way of assigning such age to the formation as the geologic and paleontologic conditions require.

Cooke (1945, p. 305) has revived discussion on the interpretation of the source of fossils found in stratum no. 2 of the Vero section which he regards as having been secondarily deposited. The geologic section at Vero where the drainage canal cuts the valley of Van Valkenburg Creek consists of the following units (from base of section upward): (1) the Anastasia formation, a shell deposit which underlies this

region; (2) a stratum of sand, stained brown by organic matter, and with inclusions of organic materials; (3) stratum consisting of sand lenses and vegetable debris; and (4) a fresh-water marl, locally present. Human relics are found in strata 2 and 3 but not in stratum 1. Stratum 3 is separated from stratum 2 by an erosional unconformity; stratum 2 rests unconformably on stratum 1.

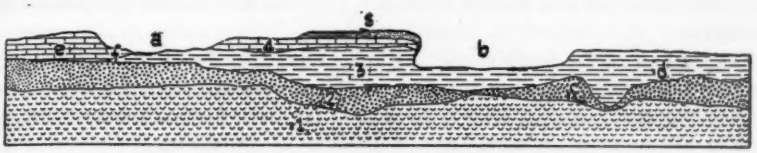

FIGURE 1.—*Section of south canal bank at Vero, Florida*

From entrance of lateral canal, west 77 feet. Looking south. Horizontal and vertical scale: 1 in. = 17.5 ft. (Adapted from Sellards, 1917, p. 10.)

(1) Marine shell deposit; (2) dark sand stratum; (3) stratified deposit of incoherent sand lenses and vegetable debris; (4) sandy marl locally present. (a) cut into the formation, made probably by dredging operations; (b) channel of Van Valkenburg Creek; (c) location of human bones, artifacts, and flint spawls in stratum 2; (d) location of human bones, including the skull described by Dr. Stewart; (e) marl resting on stratum 2; (f) lateral gradation from stratum 3 to stratum 4. Near the middle of the section at s is a remnant of soil overlying the marl. The human skull was broken into many pieces and scattered over a considerable area, all pieces having been found at the contact between strata 2 and 3. The skull may or may not have been derived from stratum 2, where some human bones still remain, as at c of this section.

Stratum 3 has been named the Van Valkenburg beds (Sellards, 1940a, p. 383); the underlying unit, referred to in all of the writer's earlier papers as stratum 2, was identified by Cooke and Mossom (1929, p. 218) as the Melbourne bone bed, and that name was accepted for this stratum in the writer's 1940 paper. At the present time Cooke apparently does not identify stratum 2 of this section as the Melbourne bone bed but as a later formation. The idea that the vertebrate fossils of stratum 2 were secondarily deposited was advanced by Chamberlin in 1917, but neither he nor the writer could locate a source from which they could have been derived.

The writer's initial paper on this locality (Sellards, 1916a, p. 4) contains a section of the canal bank at a locality where human bones were first found in these deposits. The section at this place contained three units, as follows:

	Thickness Ft.	Thickness ins.
Sandy hard marl rock	1	3
Sand, stained brown by organic matter	3	9
Marine shell deposit to water level in canal	5	9

The shell bed is the Anastasia formation. In 1916 the writer regarded the two overlying units, the brown sand and the marl, as being contained in stratum 2 of the general section (Sellards, 1916a, p. 7; 1916b, p. 129). Later (1917, p. 20), after the section had been fully exposed and studied, the writer found that a marl overlies both strata 2 and 3. A section on the south bank of the canal just west of the entrance of the lateral canal is shown in Figure 1. This section proves the position of the marl as overlying both strata 2 and 3. The place in the section to which Cooke refers is just east of the canal entrance where the marl rests directly on stratum 2, as it does just west of the lateral canal entrance in this section. Cooke apparently interprets this particular spot in the section differently from the remainder of the

section, refers the sand stratum here to the Pamlico formation, and seems to consider it the source of the fossils now found in stratum 2 of the Vero section, an interpretation not in agreement with the writer's observations made in 1916 and 1917, when the canal banks were carefully cleared for study. Sections of both the north and south banks of the canal across Van Valkenburg Creek valley, showing stratum 2 to be continuous across and beyond the valley, are given in the writer's papers of 1916 and 1917.

That the vertebrate fossils of stratum 2 are secondarily deposited is disproved by the fact that certain of them are much too fragile to have been moved by flood waters after fossilization. Among these is the skull of the tapir, *Tapirus veroensis* (Sellards, 1918, p. 57), found in the north bank of the canal in stratum no. 2, 460 feet west of the railroad bridge. Another almost equally fragile fossil is the skull of the wolf, *Aenocyon ayersi*, found in stratum 2 on the north bank of the canal, 100 feet west of the railroad bridge. Additional evidence that the fossils of this stratum are primary is given elsewhere (Sellards, 1937, p. 208).

Stratum 3 of this section was formed under conditions of violent stream erosion and contains vertebrate bones and marine shells, mostly broken, some of which were derived from the underlying deposits. In this respect it contrasts strongly with stratum 2, which was formed under relatively quiet conditions and contains no secondarily deposited fossils, except possibly a few shells near the base derived from the immediately underlying shell beds. The writer has several times discussed the probable age of stratum no. 3. In the earliest papers (1916a; 1916b) its age was considered indeterminate. Later (1917), with the continued accumulation of fossils found in stratum 3, it was thought that the erosional unconformity between strata 2 and 3 might represent no great interval of time, and that stratum 3 might date as early as late Pleistocene. At the present time the writer regards strata 3 and 4 of this section as Recent in age; the erosional unconformity between strata 2 and 3 as representing an important time break; and stratum 2 as of Pleistocene age.

GEORGIA

Macon.—Various sites in the Ockmulgee drainage basin near Macon, Georgia. Extensive collections made from 1933 to 1938. Principal publications: Cotter (1937, p. 28); Kelly (1938); Haag (1942, p. 217); Roberts (1940b, p. 56, 62).

The artifacts, of which large collections were made, include a fluted point, scrapers, knives, drills, and perforators. No vertebrate fossils are reported.

KANSAS

Garden City.—Two gravel pits worked for road material near Garden City have yielded artifacts. Publication: Graffham (1944).

An artifact made from basalt was found in place in a gravel pit at a depth of 2 feet below the soil zone. The author makes no comment as to the possibility of a human burial at this place. No fossils were found in this pit. In another pit two pieces of worked basalt were found. The author makes no comment as to whether or not these were in place or, if in place, the depth. Fossils obtained from this pit include teeth of mammoth, horse, and bison.

Russell Springs.—The artifact from this locality, found in 1895, disappeared the writer is informed, from the University of Kansas collection shortly after it was brought to the laboratory. Mr. H. T. Martin, who made the discovery, fortunately had made a photograph of the artifact which was published by Renaud (1928, p. 31), and line drawings appear in at least four publications. The first illustration to be published was by Wilson (1901, p. 305), who, by error, refers to the artifact as from Wyoming. Boule (1923, p. 400) reproduces Wilson's illustration. An unexplained illustration is included in a paper written in 1902 by Williston (1905, p. 336). This illustration is reproduced by Osborn (1910, p. 497).

KENTUCKY

Parrish.—Locality in Hopkins County, western Kentucky. Publication: Haag (1942, p. 217).

This locality, according to Haag, contains a Folsom-like culture. Burials were found, but the bones were badly disintegrated. It is a nonpottery locality, and stratigraphic evidence, if obtainable, has not yet been published.

MINNESOTA

Pelican Rapids, Browns Valley, and Sauk Valley.—Publication: McCown (1941).

MISSOURI

Benton and Gasconade Counties.—Publications: Montagu (1942); Montagu and Peterson (1944).

NEVADA

Etna Cave.—Locality a small cave near Etna, about 6 miles south of Caliente. Publications: Roberts (1944); Wheeler (1942).

Four levels containing evidence of man are found in this cave. The two uppermost are identified as Pueblo and Basketmaker; the third somewhat resembles the Gypsum Cave culture, and the fourth contains a broken Yuma-like projectile point. In this basal stratum was found, also, a small piece of slate rock with markings regarded by Wheeler as engravings made by man. The stone is illustrated by photograph only, but certain of the engravings, as nearly as can be determined from the photograph, resemble engravings on a proboscidian tusk described by the present writer from stratum 2, Vero, Florida. Fossils of the deeper horizons are camel, ground sloth, and evidence of the presence of a small horse at what is considered as the Gypsum Cave level.

Great Basin.—Locality in the Great Basin. Publication: Campbell, Elizabeth W. Crozer, and Campbell, William H. (1940).

Announcement of this locality indicates a Folsom complex in the Great Basin. The locality has not yet been fully explored.

Gypsum Cave.—Publication: Amsden (1944).

NEW MEXICO

Clovis.—Publications: Cotter (1938); Price (1944); Sellards (1940a).

Estancia Valley.—Locality on top of the north terrace of ancient Estancia Valley Lake, about 5 miles north of Moriarty. Publication: Hurt (1942).

At this locality artifacts are exposed by wind erosion. Two Folsom points of the very small, or pygmy, type were found here. Other points have been found on the surface in this region. No associated fossil vertebrates have been found.

Folsom.—Publications: Cassell (1941); Wormington (1944).

Grants.—Locality includes numerous sites in blow outs where the wind has removed the sand of ancient dunes. Publications: Bryan and McCann (1943); Bryan and Toulouse (1943).

Artifacts of late and early cultures are found at this locality. No definite relationship to fossils has been established.

Hermit Cave.—Locality in the Guadalupe Mountains. Publication: Schultz (1943).

The remains of the dire wolf and a proboscidian were found in this cave. Associated with the fossils were charcoal, burned wood, and split bones. Some of the split bones were partly burned.

Sandia Cave.—Publications: Bliss (1940a; 1940b); Brand (1940); Bryan (1941a; 1941b); Hibben (1940; 1941a; 1941b; 1944).

The Sandia culture in this cave underlies Folsom culture. Bryan (1941) places the Sandia culture as preceeding the climax of Wisconsin substage III, and the Folsom culture layer in the cave as having been formed immediately following the climax of Wisconsin III glacial stage.

San Jon District.—Locality near the west rim of the Llano Estacado, 10½ miles south of San Jon. Publication: Roberts (1942a).

One type of projectile point found at this locality is associated with a large fossil bison, probably *Bison taylori.* Other projectile points were found in other horizons which are unlike the San Jon point and are believed to be of later age.

OREGON

Lebanon.—Locality a spring near Lebanon. Publication: Cressman and Laughlin (1941).

A tooth and parts of the skeleton of an elephant were found at this locality. Near one of the bones was a stone, apparently worked and believed to be an artifact.

Paisley Five Mile Point No. 3 Cave or Shelter.—Publications: Cressman (1939; 1940a, p. 195; 1940b, p. 301; 1941, p. 175); Cressman and Williams (1940); Cressman and others (1942).

This locality affords, according to the authors, definite record of human relics in association with extinct animals. The human materials include worked basalt chips. The extinct animals found are camel and horse.

Roaring Springs Cave.—Locality in Catlow Valley in south-central Oregon, about 75 miles south of Burns. Principal publications: Cressman and Krieger (1940); Cressman and others (1942).

Roaring Springs Cave contains two habitation levels. The atlatl and bow are found in the upper bed, but of greater significance is the underlying prebasketry level with atlatl and crude artifacts.

Wikiup Dam Site.—Locality a dam site on Deschutes River. Publication: Cressman (1937).

At this locality two knives or side scrapers were removed by shovel from the side of a pit at a depth of 5 feet. The overlying strata consisted of thin humus soil, followed in order by pumice, 30 inches; yellow soil and scattered pebbles, 15 inches; yellow sandy soil and gravel, 15 inches; partially cemented sand, 4 to 6 inches. The artifacts were found lying on this hardened layer. No fossils are reported from the excavation. Cressman considers the artifacts as late glacial or early postglacial.

Other Oregon caves containing human materials described by Cressman and others are Catlow Cave no. 1; Paisley Five Mile Point Caves 1 and 2; and Fort Rock Cave.

TEXAS

Abilene.—Publications: Ray (1940a; 1940b; 1943a; 1943b; 1945); Roberts (1945b); Stewart (1945).

Berclair Terrace.—A series of localities in the terrace of Blanco Creek in Bee and Goliad counties. The first locality discovered is on the Buckner ranch and has been referred to as the Buckner locality (Sellards, 1940a). Principal publications: Bryan (1941a); Campbell (1940); Evans (1940); Sellards (1940a; 1940b).

Extensive collections of fossils were made in Bee and Goliad counties, Texas, in 1938 to 1940. The fossils occur in a terrace of Blanco Creek which has been named the Berclair terrace (Sellards, 1940b, p. 1632). Collections were made from 15 localities in this terrace. Of these, 6 sites yielded artifacts in association with vertebrate fossils. The mammalian fauna of the terrace includes chiefly extinct species, while the invertebrate fauna, fresh-water shells, consists entirely of existing species. The artifacts found in the basal part of the terrace include a few Folsom and Yuma or Yuma-like points. At the same level and extending to a somewhat higher level are stemmed points. At a still higher level are other artifacts which may represent a later culture. The extinct mammalian species found in association with artifacts in this terrace are as follows: *Parelephas columbi, Archidiskodon imperator, Mastodon americanus, Equus gigantius, E. complicatus, E. fraternus, Bison* sp., *Camelops* sp., *Platygonus* sp., *Aenocyon ayersi, Holmesina septentrionalis, Glyptodon petaliferus.*

Big Bend region.—Various localities in this region. Principal publications: Albritton and Bryan (1939, geology of the region); Kelley, Campbell, and Lehmer (1940, archaeology of the region).

The alluvium of this region has been divided by Albritton and Bryan (1939' p. 1425) into three formations in order of age: Neville, Calamity, and Kokernot. The Neville, the oldest formation, contains at least one extinct animal, the elephant. From the other two formations no extinct species have been obtained. No human materials have been obtained from the Neville formation, although one grindstone was obtained from deposits that may represent this formation; the Calamity formation contains artifacts, hearths, and human skeletons; the Kokernot contains cultural materials. Pottery is found only in the uppermost part of the Kokernot formation.

Hopper Ranch.—Publications: Barbour and Schultz (1941); Schultz (1943).

Malakoff.—Publication: Sellards (1941).

McLean.—Publication: Ray, Cyrus N. (1942).

Plainview.—Locality a pit for road material at Plainview. Publications: Sellards (1945); Sellards, Evans, Meade, and Krieger (1947).

This fossil bison quarry, containing artifacts, discovered in 1944, was excavated in 1945. The bone bed, ranging in thickness from a few inches to 1½ feet, is in a former stream channel at the base of valley fill. At the top of the bone bed the bones are more or less broken, while at lower levels and at the bottom the bones are usually complete and often in articulation. Whole skeletons are preserved but are difficult or impossible to separate from associated skeletons. The accumulation of bison skeletons may have resulted from a bison stampede. Excavation of 500 square feet of the bone bed yielded parts of skeletons of an estimated 100 bison (*B. taylori*). The artifacts obtained include projectile points, an end scraper, five side scrapers or knives, and two flake scrapers. The projectile points are distinctive and are designated the Plainview point. Fresh-water invertebrates present are of existing species. From near-by localities in the valley fill have been obtained *Parelephas columbi*, *Equus* sp., and an end scraper.

WYOMING

Agate Basin.—Locality in Agate Basin midway between Newcastle and Luck.

The locality, reported by Roberts (1943b), is said to represent a bison kill. The associated points, of which 32 were obtained in place in the deposits, suggest "collateral Yuma" and appear to represent a cultural unit. The bison at this locality is said to be the modern species. Publication of a summary of investigations at the locality has been delayed by the war (Roberts, letter of July 23, 1945).

Finley.—Locality about 4½ miles east of Eden in southwestern Wyoming. Principal publications: Hack (1943); Howard (1943b); Howard, Satterthwaite, Jr., and Bache (1941).

The artifacts at this locality were obtained from a stratum of sandy clay underlying dune sand. With the artifacts are bones of *Bison*, sp. indet. Invertebrates from the bone bed are of existing species. This is the type locality of Howard's Eden Yuma point. Scottsbluff Yuma is present; also some other Yuma-like points. Hack regards the culture layer as probably postglacial in age.

ARGENTINA

CÓRDOBA

Gruta de Cadonga.—Locality a cave in the province of Córdoba. Principal publications: Castellanos (1943); Bryan (1945).

Four horizons are recognized in this cave; the two uppermost are pottery bearing. In the next underlying stratum, pottery is wanting. The recognizable fossils found at this level include dermal bones of *Mylodon* and fresh-water shells of species living in this region. The fourth or lowermost stratum was found to contain bone points, scrapers, remains of extinct animals, part of the skull of a child, burnt animal bones, and a hearth. The basal stratum is separated from the overlying materials by an erosional unconformity.

CONCLUDING STATEMENT

CONDITIONS OF OCCURRENCE

Most of the new localities for early man noted in this paper afford stratigraphic data useful in forming an idea of the age of the human materials. In addition, extinct species of animals are reported to have been found with the human materials in 14 of the 34 new localities listed. A few localities lacking both stratigraphic and paleontologic support are included on the basis of the contained artifacts.

EXTINCT MAMMALIAN SPECIES

The list of extinct mammalian species associated with human materials in the North American localities has not been increased during 1940 to 1945, except in the Fairbanks region of Alaska, where the conditions of occurrence indicate possible mixing of materials. A summary of the principal extinct mammals associated with human relics in North America and South America will be found in the 1940 paper (p. 405–408).

LOCALITIES LACKING EXTINCT SPECIES

A larger than average number of localities of prepottery age but apparently not of such age as to contain extinct species have been described in late years. Among these are localities in the Big Bend region of Texas and in the region of the Cochise culture in Arizona. The deposits in which is found the earliest of the Cochise culture, the Sulphur Springs stage, according to Sayles and Antevs, contain extinct species, including horse, dire wolf, and mammoth, while the overlying deposits, in which are found the Chiricahua and San Pedro culture stages, do not contain extinct species. In the Big Bend region Albritton and Bryan recognize three geologic formations of alluvial deposits—Neville, Calamity, and Kokernot. The Neville formation, in which has been found one extinct species, the elephant, is not known to contain human materials. The Calamity formation contains artifacts, described by Kelley, Campbell, and Lehmer but no extinct species. The Kokernot, the latest of the three formations, contains pottery, at least near the top. In the streams of the West Texas region Evans and Meade (1945) recognize two benches or late terraces which contain a wholly recent fauna. These several researches emphasize the considerable time interval included in the geologically Recent period and also add to the improbability of any great time break between the Folsom and succeeding cultures.

CLIMATE AND EARLY MAN

A considerable number of papers relating to climate have appeared in recent years; investigations have been made in this field by Bryan, Antevs, and others. These investigations support the theory of recognizable climatic cycles in late geologic time and their important effect on human habits and habitations. The bibliography contains some, but by no means all, of the recent papers on climate.

IMPLEMENTS USED BY EARLY MAN IN HUNTING ELEPHANT AND BISON

The association of artifacts with remains of various extinct species is now so well established as scarcely to call for special mention. Much more rare is the recovery of artifacts that can be said with confidence to have been used in killing, skinning, or otherwise processing certain animals. The best records of this kind thus far obtained relate to the bison and elephant. The most recently discovered localities affording information of implements used in hunting bison are at Plainview and Hopper ranch, Texas. At each of these localities artifacts have been found with bison under conditions indicating that they had been used in killing or processing these animals. Earlier similar discoveries have been made at several localities, among which are Folsom, New Mexico, and Lindenmeier, Colorado.

Implements believed to have been used in hunting the elephant have been reported at a few localities, one of which is the Cowan ranch, Roberts County, Texas (Sellards, 1938). The locality is an ancient water hole, now filled, containing the remains of several elephants. The artifacts found with the elephant skeletons have been illustrated by Sellards (1938). Points similar to these have been found with elephant remains at several other localities, among which are Dent, Colorado; McLean, Texas; and Clovis, New Mexico (Figgins, 1933; Ray, C. N., 1942; Cotter, 1938).

The points found with extinct bison are in general smaller than are the points found with the elephant. Thus, the Plainview points are 65–74 mm. long and 22–25 mm. wide (Sellards, Evans, Meade, and Krieger, 1947); those found at the Hopper ranch locality are from 50 to about 68 mm. long and 20 to 23.8 mm. wide (Schultz, 1943). The three points found with the elephants from Cowan ranch are 76–116 mm. long and 25–30 mm. wide. The points found at Dent, Colorado; McLean, Texas; and Clovis, New Mexico, are 83–114 mm. long and 25–37 mm. wide, thus indicating, as suggested by Cotter, that larger points were used for the elephant than for the bison.

SELECTED BIBLIOGRAPHY (1940–1945) AND REFERENCES CITED

Adams, Robert McCormick (1940) *Diagnostic flint points*, Am. Antiquity, vol. 6, p. 72–75.

Albritton, Claude C., Jr., (1941) *See* Huffington, Roy M., and Albritton, Claude C., Jr. (1941).

———, and Bryan, Kirk (1939) *Quaternary stratigraphy in the Davis Mountains, Trans-Pecos Texas*, Geol. Soc. Am., Bull., vol. 50, p. 1423–1474.

———, and Pattillo, L. Gray, Jr. (1940) *A human skeleton found near Carrollton, Texas, geology of the site*, Field and Laboratory, vol. 8, p. 59–62.

Allison, Ira S. (1946) *Early man in Oregon: pluvial lakes and pumice*, Sci. Mo., vol. 62, p. 63–65.

Amsden, Charles (1944) *America's earliest man*, The Masterkey, vol. 18, no. 1, p. 5–12. Also issued as Southwest Mus. Leaflets, no. 4, 2d ed., 1944.

Antevs, Ernst (1939a) *in* Harrington, M. R. (1939b) *Age of the Borax Lake finds*, p. 209.

———(1939b) *Studies on the past climate in relation to man in the Southwest*, Carnegie Inst. Washington, Yr. Bk., no. 38, p. 317–319.

———(1940) *Age of artifacts below peat beds in Lower Klamath Lake, California*, Carnegie Inst. Washington Yr. Bk., no. 39, p. 307–309.

——— (1941) *Age of the Cochise culture stages*, Medallion Papers, no. 29, p. 31–56.

——— (1944) *Regarding J. C. Jones' date for Lake Lahontan*, Am. Antiquity, vol. 10, p. 211.

——— (1945) *Correlation of Wisconsin glacial maxima*, Am. Jour. Sci., vol 243-A, p. 1–39.

Arellano, Alberto R. V. (1946) *Datos geológicos sobre la antigüedad del hombre en la cuenca de Méjico*, Memo. Segundo Cong. Mex. Ciencias Sociales, vol. 5, p. 213–219.

Bache, Charles (1941) *See* Howard, Edgar B., Satterthwaite, Linton, Jr., and Bache, Charles (1941).

Barbour, E. H., and Schultz, C. Bertrand (1941) *A new fossil bovid from Nebraska with notice of a new bison quarry in Texas*, Nebr. State Mus., Bull., vol. 2, no. 7, p. 63–68.

Bartlett, Katherine (1943) *A primitive stone industry of the Little Colorado Valley, Arizona*, Am. Antiquity, vol. 8, p. 266–268. (Reprinted with some changes from The Plateau, Mus. Northern Arizona, vol. 14, no. 3, Jan. 1942).

Bliss, Wesley L. (1939) *Early man in western and northwestern Canada*, Science, vol. 89, p. 365–366.

——— (1940a) *A chronological problem presented by Sandia Cave, New Mexico*, Am. Antiquity, vol. 5, p. 200–201.

——— (1940b) *Sandia Cave*, Am. Antiquity, vol. 6, p. 77–78.

Boule, Marcellin (1923) *Fossil men: elements of human palaeontology*, Transl. from French, with introduction by Jessie Elliot Ritchie and James Ritchie.

Brand, Donald D. (1940) *Regarding Sandia Cave*, Am. Antiquity, vol. 5, p. 339.

——— (1944a) *A note on Baja California*, Soc. Mex. Antropologia: Terc. Reunion Mesa Redonda, Mexico City, p. 163–164.

——— (1944b) *A note on the pre-ceramic man in northern Mexico*, Soc. Mex. Antropologia: Terc. Reunion Mesa Redonda, Mexico City, p. 164.

Brew, John Otis (1943) *A selected bibliography of American Indian archaeology east of the Rocky Mountains*, Excavators' Club, Papers, vol. 2, no. 1, 90 pages.

Brinton, Daniel G. (1887) *On ancient human footprints from Nicaragua*, Am. Philos. Soc., vol. 24, p. 437–444.

Browne, Jim (1940) *Projectile points*, Am. Antiquity, vol. 5, p. 209–213.

Bryan, Kirk (1939) *Stone cultures near Cerro Pedernal, New Mexico, and their geologic antiquity*, Texas Arch. Paleont. Soc., vol. 11, p. 9–46.

——— (1939) *See* Albritton, Claude, C., Jr., and Bryan, Kirk (1939).

——— (1941a) *Geologic antiquity of man in America*, Science, vol. 93, p. 505–514.

——— (1941b) *Correlation of the deposits of Sandia Cave, New Mexico, with the glacial chronology*, Smithson. Misc. Coll., vol. 99, no. 23, p. 45–64.

——— (1941c) *Pre-Columbian agriculture in the southwest as conditioned by periods of alluviation*, Assoc. Am. Geog., Ann., vol. 31, p. 219–242. Printed also, slightly condensed, in 8th Am. Sci. Cong., Pr., vol. 2, p. 57–74, 1942.

——— (1945) *Recent work on early man at the Gruta de Cadonga in the Argentine Republic*, Am. Antiquity, vol. 11, p. 58–60.

——— (1946) *Commentario e intento de correlación con la cronología glacial*, Mem. Seg. Cong. Mex. Ciencias Sociales, vol. 5, p. 220–225.

———, and McCann, Franklin T. (1943) *Sand dunes and alluvium near Grants, New Mexico*, Am. Antiquity, vol. 8, p. 281–290.

———, and Ray, Louis L. (1940) *Geologic antiquity of the Lindenmeier site in Colorado*, Smithson. Misc. Coll., vol. 99, no. 2, 76 pages.

———, and Toulouse, Joseph H., Jr. (1943) *The San Jose non-ceramic culture and its relation to a puebloan culture in New Mexico*, Am. Antiquity, vol. 8, p. 269–280.

Byers, Douglas S. (1943) *A new site*, Am. Antiquity, vol. 8, p. 300.

Campbell, Elizabeth W. Crozer, and Campbell, William H. (1940) *A Folsom complex in the Great Basin*, The Masterkey, vol. 14, p. 7–11.

Campbell, T. N. (1940) *Notes on artifacts*, Geol. Soc. Am., Bull., vol. 51, p. 1640–1644.

——— (1940) *See* Kelley, J. Charles, Campbell, T. N., and Lehmer, Donald J. (1940).

Cassell, Raymond K. (1941) *A postulated corridor of Folsom migration*, Mich. Acad. Sci., Arts, Letters, Papers, vol. 26, p. 451–457.

Castellanos, Alfredo (1943) *Antigüedad geólogica del yacimiento de los restos humanos de la Gruta de Cadonga (Córdoba)*, Publ. Inst. Fisiographía y Geol., Univ. Nac. Litoral, no. 14.

Chaffee, Robert G. (1939) *See* Colbert, Edwin H., and Chaffee, Robert G. (1939).

Chamberlin, R. T. (1917) *Further studies at Vero, Florida*, Jour. Geol., vol. 25, p. 667–683.

Chaney, Ralph W., and Mason, Herbert L. (1936) *A Pleistocene flora from Fairbanks, Alaska*, Am. Mus. Nat. Hist., Novit., no. 887.

Colbert, Edwin H. (1940) *Mammoth and man*, Nat. Hist., vol. 46, p. 96–103.

——— (1942a) *The association of man with extinct mammals in the Western Hemisphere*, 8th Am. Sci. Cong., Pr., vol. II, p. 17–29.

——— (1942b) *The Pleistocene faunas of Asia and their relationships to early man*, New York Acad. Sci. Tr., ser. II, vol. 5, no. 1, p. 1–10.

———, and Chaffee, Robert G. (1939) *A study of Tetrameryx and associated fossils from Papago Spring Cave, Sonoita, Arizona*, Am. Mus. Nat. Hist., Novit., no. 1034, 21 pages.

Collins, Henry B., Jr. (1937) *Arctic area*, Am. Antiquity, vol. 3, p. 188.

——— (1943) *Eskimo archaeology and its bearing on the problem of man's antiquity in America*, Am. Philos. Soc., Pr., vol. 86, no. 2, p. 220–235.

Cooke, C. Wythe (1945) *Geology of Florida*, Fla. Geol. Survey, Geol. Bull., no. 29, 339 pages.

———, and Mossom, Stuart (1929) *Geology of Florida*, Fla. Geol. Survey, 20th Ann. Rept., p. 29–227.

Cordero, Julio Febres G. (1944) *Nuestras Oleadas de Migracion Arcaica*, Acta Am., vol. 2, nos. 1, 2, p. 51–57.

Cotter, J. L. (1937) *The significance of Folsom and Yuma artifact occurrences in the light of typology and distribution*, Philadelphia Anthropol. Soc., 25th Anniv. Stud., vol. 1, p. 27–35.

——— (1938) *The occurrence of flints and extinct animals in pluvial deposits near Clovis, New Mexico. Part VI,—Report on field season of 1937*, Acad. Nat. Sci. Philadelphia, Pr., vol. 90, p. 113–117.

Cressman, Luther Sheeleigh (1937) *The Wikiup damsite no. 1 knives*, Am. Antiquity, vol. 3, p. 53–67.

——— (1939) *Early man and culture in the Northern Great Basin Region of south-central Oregon*, Carnegie Inst. Washington, Yr. Bk. 1938–1939, no. 38, p. 314–317.

——— (1940a) *Early man and culture in south-central Oregon*, Am. Philos. Soc., Yr. Bk. 1939, p. 194–196.

——— (1940b) *Studies on early man in south-central Oregon*, Carnegie Inst. Washington, Yr. Bk., no. 39, p. 300–306.

——— (1940c) *Early man and culture in the Northern Great Basin Region of south-central Oregon. Preliminary report*, Univ. Oregon Mon., Stud. Anthropol., no. 3, p. 1–15.

——— (1941) *Early man in the Northern Great Basin Region of south-central Oregon*, 6th Pac. Sci. Cong., Pr., vol. 4, p. 169–175.

——— (1942) *Archaeological researches in the Northern Great Basin* (with collaboration of Frank C. Baker, Henry P. Hansen, Paul S. Conger, and Robert F. Heizer), Carnegie Inst. Washington, Pub. 538, 158 pages.

——— (1943) *Results of recent archaeological research in the Northern Great Basin Region of south-central Oregon*, Am. Philos. Soc., Pr., vol. 86, no. 2, p. 236–246.

——— (1944a) *Reply to A. D. Krieger's review of L. S. Cressman's Archaeological researches in the Northern Great Basin*, Am. Antiquity, vol. 10, p. 206–211.

——— (1944b) *New information on south-central Oregon atlatls*, The Masterkey, vol. 18, p. 169–179.

——— (1945) *A case of probable osteomyelitis in an Indian skeleton*, Western Jour. Surgery, Obstetrics, Gynecology, vol. 53, p. 332–335.

——— (1946) *Early man in Oregon: straligraphic evidence*, Sci. Mo., vol. 62, p. 43–51.

———, and Krieger, Alex. D. (1940) *Atlatls and associated artifacts from south-central Oregon*, Univ. Oregon Mon., Stud. in Anthropol., no. 3, p. 16–52.

———, and Laughlin, W. S. (1941) *A probable association of mammoth and artifacts in the Willamette Valley, Oregon*, Am. Antiquity, vol. 6, p. 339–342.

———, and Williams, Howel (1940) *Early man in south-central Oregon: evidence from stratified sites*, Univ. Oregon Mon., Stud. in Anthropol., no. 3, p. 53–78.

Cummings, Byron (1927) *Cochise's yesterday*, The Tombstone Epitaph, vol. 49, no. 4, p. 12-25.

——— (1928) *Cochise of yesterday*, Arizona, Old and New, vol. 1, no. 4, p. 9–10, 26–28.

DeTerra, Helmut (1946) *Stones and bones*, Time, The Weekly Magazine, vol. 47, March 25, 1946, p. 92, 95.

Eiseley, Loren C. (1941) *Review of E. H. Sellards: Early man in America, index to localities and selected bibliography*, Am. Antiquity, vol. 7, p. 84–85.

——— (1942a) *Post-glacial climatic amelioration and the extinction of* Bison taylori, Science, n.s., vol. 95, p. 646–647.

——— (1942b) *The Folsom mystery*, Sci. Am., vol. 167, p. 260–261.

——— (1942c) *Review of Frank C. Hibben: Evidences of early occupation in Sandia Cave, New Mexico, and other sites in the Sandia Manzano region*, Am. Antiquity, vol. 7, p. 415–417.

——— (1943a) *Archaeological observations on the problem of post-glacial extinction*, Am. Antiquity, vol. 8, p. 209–217.

——— (1943b) *Pseudo-fossil man*, Sci. Am., vol. 168, p. 118–119.

——— (1943c) *Did the Folsom bison survive in Canada?*, Sci. Mo., vol. 56, p. 468–472.

——— (1943d) *Review of Raymond W. Murray: Man's unknown ancestors*, Am. Jour. Phys. Anthropol., vol. 1 (n. s.), p. 428–429; Am. Anthropol., n. s., vol. 46, p. 255–256, 1944.

——— (1944) *Review of Morris F. Skinner: The fauna of Papago Springs Cave, Arizona, and a study of* Stockoceros; *with three new Antilocaprines from Nebraska and Arizona*, Am. Antiquity, vol. 9, p. 460–461.

——— (1945a) *Indian mythology and extinct fossil vertebrates*, Am. Anthropol., vol. 47, p. 318–320.

——— (1945b) *The mastodon and early man in America*, Science, n. s., vol. 102, p. 108–110.

——— (1945c) *Myth and mammoth in archaeology*, Am. Antiquity, vol. 11, p. 84–87.

——— (1946a) *The fire-drive and the extinction of the terminal Pleistocene fauna*, Am. Anthropol., vol. 48, p. 54–59.

——— (1946b) *Men, mastodons and myth*, Sci. Mo., vol. 62, p. 517–524.

——— (1946c) *Review of F. E. Zeuner: The Pleistocene period*, Am. Jour. Phys. Anthropol., vol. 4 (n.s.), p. 107–108.

Evans, Glen L. (1940) *Notes on terrace deposits*, Geol. Soc. Am., Bull., vol. 51, p. 1644–1649.

——— (1947) *See* Sellards, E. H., *et al.* (1947).

———, and Meade, Grayson E. (1945) *Quaternary of the Texas High Plains*, Univ. Texas, Pub. 4401, p. 485–507.

Fenenga, Franklin (1940) *A reply to "Folsom and Nepesta points"*, Am. Antiquity, vol. 6, p. 78–79.

Figgins, J. D. (1933) *A further contribution to the antiquity of man in America*, Colo. Mus. Nat. Hist., Pr., vol. 12, no. 2, p. 4–8.

Fischel, Hans E. (1941) *Supplementary data on early man in America*, Am. Antiquity, vol. 6, p. 346–348.

Gillette, J. M. (1943) *Ancestorless man: the anthropological dilemma*, Sci. Mo., vol. 57, p. 533–545.

Graffham, Allen (1944) *Notes on basalt artifacts found in the Pleistocene gravels of Kansas*, Kans. Acad. Sci., Tr., vol. 47, p. 259–260.

Haag, William G. (1942) *Early horizons in the Southeast*, Am. Antiquity, vol. 7, p. 209–222.

Hack, John T. (1943) *Antiquity of the Finley site*, Am. Antiquity, vol. 8, p. 235–241.

Hansen, Henry P. (1946) *Early man in Oregon: pollen analysis and post-glacial climate and chronology*, Sci. Mo., p. 52–62.

Harrington, M. R. (1939a) *Trailing early Californians*, The Masterkey, vol. 13, p. 163–166.

——— (1939b) *The age of the Borax Lake finds*, The Masterkey, vol. 13, p. 208–209.

——— (1942) *Return to Borax Lake*, The Masterkey, vol. 16, p. 214–215.

——— (1945) *Farewell to Borax Lake*, The Masterkey, vol. 19, p. 181–184.

——— (1946) *New work at Borax Lake*, The Masterkey, vol. 20, no. 6, p. 189–190.

Haury, Emil W. (1943) *The stratigraphy of Ventana Cave, Arizona*, Am. Antiquity, vol. 8, p. 218–223.

Hibben, Frank C. (1940) *Sandia man*, Sci. Am., vol. 163, p. 14–15.

——— (1941a) *Evidences of early occupation in Sandia Cave, New Mexico, and other sites in the Sandia-Manzano region*, (with appendix on correlation of the deposits of Sandia Cave, New Mexico: glacial chronology by Kirk Bryan), Smithson. Misc. Coll., vol. 99, no. 23, p. I–VI, 1–44.

——— (1941b) *Sandia Cave*, Am. Antiquity, vol. 6, p. 266.

——— (1941c) *Archaeological aspects of the Alaska muck deposits*, N. M. Anthropol., vol. V, no. 4, p. 151–157.
——— (1942) *Pleistocene stratification in the Sandia Cave, New Mexico*, 8th Am. Sci. Cong., Pr., vol. 2, p. 45–48.
——— (1943) *Evidences of early man in Alaska*, Am. Antiquity, vol. 8, p. 254–259.
——— (1944) *Our search for the earliest Americans*, Harper's Magazine, vol. 189, July, p. 139–147.
Hooton, Earnest Albert (1937) *Biology and fossil man*, in *Apes, men and morons*, G. P. Putnam's Sons New York.
Howard, Edgar B. (1940) *Studies bearing upon the problem of early man in Florida*, Carnegie Inst. Washington, Yr. Bk., no. 39, p. 309–312.
——— (1943a) *Folsom and Yuma problems*, Am. Philos. Soc., Pr., vol. 86, p. 255–259.
——— (1943b) *The Finley site: discovery of Yuma points*, in situ, *near Eden, Wyoming*, Am. Antiquity, vol. 8, p. 224–234.
———, Satterthwaite, Linton, Jr., and Bache, Charles (1941) *Preliminary report on a buried Yuma site in Wyoming*, Am. Antiquity, vol. 7, p. 70–74.
Hrdlička, Aleš (1918) *Recent discoveries attributed to early man in America*, Bur. Am. Ethnol., Bull. 66, 67 pages.
——— (1937) *Early man in America: What have the bones to say?*, in *Early man*, J. B. Lippincott Co., New York, p. 93–104.
——— (1940) *Review of Stanley Casson: Discovery of man*, Am. Jour. Phys. Anthropol., vol. 27, p. 168.
——— (1942) *The problem of man's antiquity in America*, 8th Am. Sci. Cong., Pr., vol. 2, p. 53–55.
Huffington, Roy M., and Albritton, Claude C., Jr. (1941) *Quaternary sands on the southern High Plains of western Texas*, Am. Jour. Sci., vol. 239, p. 325–338.
Hurst, C. T. (1937) *Early man in Colorado*, El Palacio, vol. 43, nos. 22-26.
——— (1941) *A Folsom locality in the San Luis Valley, Colorado*, Southwestern Lore, vol. 7, no. 2.
——— (1943) *A Folsom site in a mountain valley of Colorado*, Am. Antiquity, vol. 8, p. 250–253.
Hurt, Wesley R., Jr. (1942) *Folsom and Yuma points from the Estancia Valley, New Mexico*, Am. Antiquity, vol. 7, p. 400–402.
Imbelloni, Jose (1943) *The peopling of America*, Acta Am., vol. 1, p. 309–330.
Johnston, Frederick, *et al.* (1942) *The Boylston street fishweir*, Robert S. Peabody Foundation for Archaeology, Papers, vol. 2, 212 pages.
Kelley, J. Charles, Campbell, T. N., and Lehmer, Donald J. (1940) *The association of archaeological materials with geological deposits in the Big Bend region of Texas*, Sul Ross State Teachers College, Bull., vol. 21, no. 3, p. 11–173. Also listed as: West Texas Hist. and Sci. Pub., no. 10.
Kelly, A. R. (1938) *A preliminary report on archaeological explorations at Macon, Georgia*, Bur. Am. Ethnol., Anthropol., Papers, no. 1, Bull. 119, 68 pages, 12 plates.
Krieger, Alex D. (1940) *See* Cressman, Luther Sheeleigh, and Krieger, Alex. D. (1940).
——— (1944) *Review of L. S. Cressman and collaborators: Archaeological researches in the northern Great Basin*, Am. Antiquity, vol. 9, p. 351–359.
——— (1947) *See* Sellards, E. H., *et al.* (1947).
Kroeber, A. L. (1940) *Conclusions: the present status of Americanistic problems, The Maya and their neighbors*, Chap. 34, p. 460–487.
Laughlin, W. S. (1941) *See* Cressman, Luther Sheeleigh, and Laughlin, W. S. (1941).
Lehmer, Donald J. (1940) *See* Kelley, J. Charles, Campbell, T. N., and Lehmer, Donald J. (1940).
Lopatin, Ivan A. (1939) *Fossil man in the vicinity of Los Angeles, California*, 6th Pac. Sci. Cong., Pr., vol. 4, p. 177–181.
Lothrop, Samuel Kirkland (1926) *Pottery of Costa Rica and Nicaragua*, Mus. Am. Indian, Heye Foundation, New York, vol. 1, p. 101–104.
Lotrich, Victor F. (1938) *Comparison of a blade with two Folsom fragments*, Colo. Mag., vol. 15, no. 1, p. 15–17.
Mason, Herbert L. (1936) *See* Chaney, Ralph W., and Mason, Herbert L. (1936).
McCann, Franklin T. (1943) *See* Bryan, Kirk, and McCann, Franklin T. (1943).

McCown, Theodore D. (1941) *The antiquity of man in the New World*, Am. Antiquity, vol. 6, p. 203–213.

Meade, Grayson E. (1945) *See* Evans, Glen L., and Meade, Grayson E. (1945).

——— (1947) *See* Sellards, E. H., *et al.* (1947).

Montagu, M. F. Ashley (1942) *The earliest account of the association of human artifacts with fossil mammals in North America*, Science, vol. 95, p. 380–381.

———, and Peterson, C. Bernard (1944) *The earliest account of the association of human artifacts with fossil mammals in North America*, Am. Philos. Soc., Pr., vol. 87, no. 5, p. 407–419.

Mossom, Stuart (1929) *See* Cooke, C. Wythe, and Mossom, Stuart (1929).

Murray, Raymond W. (1943) *Man's unknown ancestors*, Bruce Pub. Co., Milwaukee, Wis.

Osborn, H. F. (1910) *The age of mammals in Europe, Asia and North America*, Macmillan Co., New York.

Pattillo, L. Gray, Jr. (1940) *See* Albritton, Claude C., Jr., and Pattillo, L. Gray, Jr. (1940).

Peterson, C. Bernard (1944) *See* Montagu, M. F. Ashley, and Peterson, C. Bernard (1944).

Price, W. Armstrong (1944) *The Clovis site: regional physiography and geology*, Am. Antiquity, vol. 9, no. 4, p. 401–407.

Rainey, Froelich G. (1937) *Arctic area*, Am. Antiquity, vol. 3, p. 188.

——— (1939) *Archaeology in central Alaska*, Am. Mus. Nat. Hist., Anthropol. Papers, vol. 36, pt. 4, p. 351–405.

——— (1940) *Archaeological investigations in central Alaska*, Am. Antiquity, vol. 5, p. 299–308.

Ray, Cyrus N. (1940a) *Was the American mano and metate an invention made during Pleistocene time?*, Science, vol. 91, p. 190–191.

——— (1940b) *The deeply buried Gibson site*, Texas Arch. Paleont. Soc., Bull., vol. 12, p. 223–237.

——— (1942) *Ancient artifacts and mammoth's teeth of the McLean site*, Texas Arch. Paleont. Soc., Bull., vol. 14, p. 137–138.

——— (1943a) *A Texas skeleton*, Science, vol. 98, p. 344.

——— (1943b) *Human burial covered by twenty-one feet of silt*, Texas Arch. Paleont. Soc., Bull., vol. 15, p. 110–116.

——— (1945) *Stream bank silts of the Abilene region*, Texas Arch. Paleont. Soc., Bull., vol. 16, p. 117–147.

Ray, Louis L. (1940) *See* Bryan, Kirk, and Ray, Louis L. (1940).

——— (1940) *Glacial chronology of the southern Rocky Mountains*, Geol. Soc. Am., Bull., vol. 51, p. 1851–1918.

——— (1942) *Symposium on Folsom-Yuma problems*, Science, vol. 95, p. 22–23.

Renaud, E. B. (1928) *L'antiquité de l'homme dans l'Amérique du Nord*, L'Anthropologie, vol. 38, p. 23–49.

——— (1934) *The first thousand Yuma-Folsom artifacts*, Univ. Denver, Dept. Anthropol., Mimeo., sep., 13 pages.

Richardson, F. B. (1941) *Nicaragua*, Carnegie Inst. Washington, Yr. Bk., no. 40, p. 300–302.

———, and Ruppert, K. (1942) *Nicaragua*, Carnegie Inst. Washington, Yr. Bk., no. 41, p. 269–271.

Roberts, Frank H. H., Jr. (1939) *The Folsom problem in American archaeology*, Smithson. Inst., Ann. Rept. 1938, p. 531–546.

——— (1940a) *Pre-pottery horizon of the Anasazi and Mexico, The Maya and Their Neighbors*, Chap. 24, p. 331–340.

——— (1940b) *Developments in the problem of the North American Paleo-Indian*, Smithson. Misc. Coll., vol. 100, p. 51–116.

——— (1942a) *Archaeological and geological investigations in the San Jon District, eastern New Mexico*, Smithson. Misc. Coll., vol. 103, no. 4, 30 pages.

——— (1942b) *Recent evidence relating to an early Indian occupation in North America*, 8th Am. Sci. Cong., Pr., vol. 2, p. 31–38.

——— (1943a) *Evidence for a Paleo-Indian in the New World*, Acta. Am., vol. 1, no. 2, p. 171–201.

——— (1943b) *A new site*, Am. Antiquity, vol. 8, p. 300.

——— (1944) *Etna Cave, Nevada*, Sci. Mo., vol. 59, no. 2, p. 153–155.

——— (1945a) *The New World Paleo-Indian*, Smithson. Inst., Ann. Rept. 1944, p. 403–433.
——— (1945b) *A deep burial on the Clear Fork of the Brazos River*, Texas Arch. Paleont. Soc., Bull., vol. 16, p. 9–30.
Ruppert, K. (1942) *See* Richardson, F. B , and Ruppert, K. (1942.)
Satterthwaite, Linton, Jr. (1941) *See* Howard, Edgar B., Satterthwaite, Linton, Jr., and Bache, Charles (1941).
Sauer, Carl O. (1944) *A geographic sketch of early man in America*, Geog. Rev., vol. 34, p. 529–573.
Sayles, E. B., and Antevs, Ernst (1941) *The Cochise culture*, Medallion Papers, no. 29, 81 pages.
Schultz, C. Bertrand (1941) *See* Barbour, E. H., and Schultz, C. Bertrand (1941).
——— (1943) *Some artifact sites of early man in the Great Plains and adjacent areas*, Am. Antiquity, vol. 8, p. 242–249.
———, and Stout, Thompson M. (1945) *Pleistocene loess deposits of Nebraska*, Am. Jour. Sci., vol. 243, p. 231–244.
Scoggin, Charles (1940) *Folsom and Nepesta points*, Am. Antiquity, vol. 5, p. 290–298.
Sellards, E. H. (1916a) *On the discovery of fossil human remains in Florida in association with extinct vertebrates*, Am. Jour. Sci., 4th ser., vol. 42, no. 247, p. 1–18.
——— (1916b) *Human remains and associated fossils from the Pleistocene of Florida*, Fla. State Geol. Survey, 8th Ann. Rept., p. 123–160.
——— (1917) *On the association of human remains and extinct vertebrates at Vero, Florida*, Jour. Geol., vol. 25, p. 4–24.
——— (1918) *The skull of a Pleistocene tapir including description of a new species and a note on the associated fauna and flora*, Fla. State Geol. Survey, 10th Ann. Rept., p. 57–70.
——— (1937) *The Vero finds in the light of present knowledge*, in *Early man*, J. B. Lippincott Co., New York, p. 193–210.
——— (1938) *Artifacts associated with fossil elephant*, Geol. Soc. Am., Bull., vol. 49, p. 999–1009.
——— (1940a) *Early man in America, index to localities and selected bibliography*, Geol. Soc. Am., Bull., vol. 51, p. 373–431.
——— (1940b) *Pleistocene artifacts and associated fossils from Bee County, Texas*, Geol. Soc. Am., Bull., vol. 51, p. 1627–1657.
——— (1941) *Stone images from Henderson County, Texas*, Am. Antiquity, vol. 7, p. 29–38.
——— (1945) *Fossil bison and associated artifacts from Texas* (Abstract), Geol. Soc. Am., Bull., vol. 56, p. 1196–1197.
———, Evans, Glen L., and Meade, Grayson E. (1947) *Fossil bison and associated artifacts from Plainview, Texas* (with description of artifacts by Alex D. Krieger), Geol. Soc. Am., Bull., vol. 58, p. 927–954.
Simpson, George Gaylord (1940) *Review of the mammal bearing Tertiary of South America*, Am. Philos. Soc., Pr., vol. 83, p. 649–709.
Skinner, Morris F. (1942) *The fauna of Papago Springs Cave, Arizona, and a study of* Stockoceros; *with three new Antilocaprines from Nebraska and Arizona*, Am. Mus. Nat. Hist., Bull., vol. 80, p. 143–220.
Stewart, T. D. (1945) *Report on the J. C. Putnam skeleton from Texas*, Texas Arch. Paleont. Soc., Bull., vol. 16, p. 31–39.
——— (1946) *A reexamination of the fossil human skeletal remains from Melbourne, Florida, with further data on the Vero skull*, Smithson. Misc. Coll., vol. 106, no. 10, 28 pages.
Stout, Thompson M. (1945) *See* Schultz, C. Bertrand, and Stout, Thompson M. (1945).
Strong, William Duncan (1940) *From history to pre-history in the northern Great Plains*, Smithson. Misc. Coll., vol. 100, p. 353–394.
Toulouse, Joseph H., Jr. (1943) *See* Bryan, Kirk, and Toulouse, Joseph H., Jr. (1943).
Vigfusson, Vladimar Alfred (1940) *A carved stone from D'Arcy, Saskatchewan*, Am. Antiquity, vol. 5, p. 334–335.
Walker, Edwin F. (1945) *America's Indian background*, Southwest Mus. Leaflets, no. 18.
Wallace, Alfred Russell (1887) *The antiquity of man in North America*, Nineteenth Century, vol. 22, p. 667, 679.

Wedel, Waldo R. (1940) *Culture sequences in the central Great Plains*, Smithson. Misc. Coll., vol. 100, p. 291–352.

Weidenreich, Franz (1939) *On the earliest representatives of modern mankind recovered on the soil of East Asia*, Peking Nat. Hist. Bull., vol. 13, pt. 3, p. 161–174.

Wheeler, S. M. (1942) *Archaeology of Etna Cave*, Nev. State Park Comm.

Williams, Howel (1940) *See* Cressman, Luther Sheeleigh, and Williams, Howel (1940).

Williston, S. W. (1905) *On the occurrence of an arrow-head with bones of an extinct bison*, Inter. Cong. Americanists, 13th ses., Pr., p. 335–337.

Wilson, M. Thomas (1901) *La haute ancienneté de l'homme dans l'Amérique du Nord*, L'Anthropologie, vol. 12, p. 297–339.

Witte, Adolph H. (1942) *Channelled points from Clear Fork sites in North Texas*, Texas Arch. Paleont. Soc., Bull., vol. 14, p. 27–31.

Woodward, Arthur (1937) *Atlatl dart foreshafts from the La Brea pits*, S. Calif. Acad. Sci., Bull., vol. 36, p. 41–60.

Wormington, H. M. (1944) *Ancient man in North America*, Colo. Mus. Nat. Hist., Popular Ser., no. 4, 2d ed., 89 pages.

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